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ANNALS OF THE CAPE PROVINCIAL MUSEUMS

Ann. Cape Prov. Mus.



VOLUME V • AUGUST 1966

PUBLISHED JOINTLY BY THE
CAPE PROVINCIAL MUSEUMS AT THE ALBANY MUSEUM, GRAHAMSTOWN
SOUTH AFRICA

CAPE PROVINCIAL MUSEUMS

— South Africa —

ALBANY MUSEUM

GRAHAMSTOWN

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PORT ELIZABETH

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The Annals of the Cape Provincial Museums are published jointly by the five Cape Provincial Museums situated at East London, Grahamstown, Kimberley, King William's Town and Port Elizabeth respectively. The editorial headquarters are at the Albany Museum, Grahamstown. The Journal is intended to record the results of research in the fields of pre-history, cultural history and natural history.

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J. DEACON
ALBANY MUSEUM,
GRAHAMSTOWN

An annotated list of Radio-
carbon dates for Sub-Saharan
Africa

It is fourteen years since J. Janmart submitted the first samples for radio-carbon dating from Sub-Saharan Africa, and there are now some 181 published dates for this area which are of interest to the prehistorian and research worker in the field of Quaternary studies. This paper is an attempt to assemble all the available dates published to the end of 1964 and the information pertinent to their interpretation in a single list for ease of reference.

The Carbon-14 dating method was developed by W. F. Libby in the late 1940's while engaged in research on the effects of cosmic ray bombardment of the upper atmosphere. He was able to show that the neutrons formed through cosmic rays colliding with nitrogen atoms produce the radio-isotope C14. This combines with oxygen to form a very small percentage of radiocarbon dioxide in addition to the normal CO₂ content of the atmosphere. All living matter, depending as it does on the intake of CO₂, therefore incorporates radiocarbon into its cells and all organisms therefore contain a proportion of radiocarbon in equilibrium with the atmosphere. After death the amount of radiocarbon diminishes by radioactive decay at a fixed rate so that by measuring the residual radioactivity in a sample it is possible to calculate the age of the specimen. Carbon-14 has a half-life of approximately 5730 ± 40 years, and after some 50,000 years the amount which remains is normally too small to measure thus placing a limit on the range of the method.

The method depends on the basic assumption that the percentage of radio-carbon content in the biosphere has remained substantially constant over the period of about 50,000 years for which the dating method is applicable. During the last 150 years, however, this balance has been altered by the extensive burning of fossil fuels such as coal and oil (Suess effect) and by the release of radiocarbon into the atmosphere through the explosion of nuclear bombs. However, these effects are a known quantity and the basic assumption is considered valid.

Anomalies in dates are caused by a variety of factors. In order to minimize

the effects of contamination, there are certain pretreatment techniques which are necessary to remove humic acids and organic material and these are employed by most laboratories today. In general, dates which are considered too young can be due to the penetration of the subsoil by modern tree rootlets and the introduction of humic acids. Anomalously old dates are generally due to the addition of fossil carbon and are encountered in freshwater mollusc shells (2) and to a lesser degree in marine shells, possibly due to a dilution effect resulting from the incorporation of inactive carbon derived from limestone and old humus, and also to the uneven absorption of Carbon-14 at the air-water interface (2). Resultant errors may be as great at 3000 years for modern shell samples from rivers actively cutting into old flood plains or old soil profiles (2). Isotopic fractionation or the preferential take-up of Carbon-14 (or of the lighter isotope of Carbon-12 which has the reverse effect) by the living organism will cause anomalies in the dates, making them too old (10). The use of charred ostrich eggshell as a medium for dating has also been experimented with (3), but the results were considered far too old and may possibly be due to the food habits of the ostrich.

Experiments have increased the range of materials which are now able to be used for dating purposes. The essential feature of all material suitable for radiocarbon dating is that it should be organic or that its carbon should have been derived directly or indirectly from atmospheric carbon dioxide (12). The most suitable material is charcoal where the tendency to absorb humic acids is offset by pretreatment, and other reliable materials are wood, peat, nuts, leaves, flesh, hair, etc. Bone has a relatively low carbon content and large amounts are therefore needed for processing; a method of dating bone and shell has been developed where the organic carbon (collagen in bone, conchiolin in marine shell) is separated by pretreatment from the other mineral constituents and is dated in the usual manner, but due to the decrease in the quantity of collagen with the age of the sample, the oldest specimen dated is only about 9000 years old (13). In addition, carbonates in the form of caliche, dolomite, calcite and calc tufa have been used for dating purposes in the U.S.A. and from Australia (14, 15); in Europe, the organic matter in soils and lake muds has been used to date old land surfaces and stratigraphic horizons (17).

Since the first dates were published, experiments have continued and changes have been made both in the methods of processing of the samples and in the manner of the calculation and publication of the dates. Valuable work by Haring and De Vries has extended the limit of the method back in time to about 70,000 years by an enrichment process (16) which has been used for a sample from Africa (Kalambo Falls).

Earlier determinations (before about 1956) were often run by converting the sample to solid carbon before counting; work by Libby (11), has shown that gas proportional counters are more efficient and these are in general use today. Dates processed with the solid carbon method (which tend to be younger but are not consistently so) are marked by an asterisk in the lists below. Re-calculations

of the half-life of C-14 have given a value of 5730 ± 40 years (4), the mean of three determinations, and this appears to be a closer approximation to the true half-life than the earlier values. However, in accordance with a decision of the Fifth Radiocarbon Dating Conference in Cambridge in 1962, made so as to gain time for further study before the re-publication of all dates is agreed upon, it was decided that all dates published be based on the original Libby value of 5570 ± 30 years (5). Prior to 1962, laboratories worked variously on the Libby value, or on 5568 ± 30 (Lamont (6), British Museum (7)), or on 5760 ± 40 (Louvain (8)).

The members of the Fifth Radiocarbon Dating Conference also agreed that all dates be calculated at B. P. (before the Present) 1950 (5). As a result there will be discrepancies between the A. D. / B. C. dates published here and some of those published elsewhere before 1962.

The standard deviation which accompanies each date is a statistical error encountered in the methods of counting and is not an absolute error. As explained by Robins and Swart (1), if a sample is reported at 3220 ± 120 years, there is a 2 out of 3 chance that it is between 3100 and 3340 years old, 19 chances in 20 that it is between 2980 and 3460 years old and 997 chances in 1000 that it is between 2860 and 3580 years old.

In compiling this list, a few discrepancies have been noted between dates published by the laboratories and the dates published in other papers. In such cases, the date published by the laboratory is taken as the correct one. In the case of a date not having been published by the laboratory, the date published first has been accepted here.

Structure of the Lists:

The dates published here have been grouped into three major sections:

- (a) Geological and Tree-ring dates
- (b) Archaeological dates, subdivided into:
 1. Early Stone Age and First Intermediate
 2. Middle Stone Age and Second Intermediate
 3. Later Stone Age
 4. Iron Age
- (c) Dates of Paleo-environmental interest, the list being composed largely of dates already listed in the other two sections.

Further subdivision of Sections A and B is based on geographical areas defined on the map in Fig. 1.

Column 1 lists the Laboratory numbers of the dates prefixed by the laboratory code letters which are explained in Table 2. These are followed by the date as published by the laboratory with the Before Present value above, accompanied by the standard deviation, and the A. D. / B. C. date (calculated from 1950) below. Column 3 gives the name of the site, followed by the country. Exact localities are shown on Fig. 1, and the geographical co-ordinates are given where available in the additional notes. The cultural associations (as

recognized by the excavator or submitter) are listed next, followed by the type of material submitted for dating (charcoal, peat, shell, etc.). The numbers in the last column refer to the bibliographic reference of the date quoted in the list, and these references are listed at the end of the section in question.

An asterisk in the left hand margin indicates that the solid carbon counting method was used; a query in the left hand margin indicates that either the laboratory or the excavator are not satisfied that the date is accurate.

The dates are arranged in rough chronological order, this order being interrupted where it was found more convenient to group the dates by site.

The additional notes accompanying each list have been compiled from the information accompanying each result published by the laboratory, and from any additional information in published papers which have been available to this author. Numbers in parenthesis in the text refer to bibliographic references at the end of the section.

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A. GEOLOGICAL AND TREE RING DATES

a. SOUTH AFRICA

	Lab. No.	Date	<u>B.P.</u> B. C.	Site	Associations	Sample	Reference
1.	W-246	> 38,000		Cape Flats	Pertinent to geological history of Cape Flats	Charcoal	1
2.	Y-49	> 38,000		"	"	Wood	2
3.	Y-106	> 36,000		Crawford, Cape	"	"	"
4.	Y-468	<u>37,700 ± 2000</u>	35,750 BC	Sedgefield,	Beach at 4m above present sea level	Marine shell	9
5.	Y-466	<u>6870 ± 160</u>	4920 BC	Groenvlei, Knysna	Marine incursion at 5.8m below fen surface	Humified freshwater peat	4
6.	Y-467	<u>1905 ± 60</u>	45 AD	"	2.9m below fen surface	Gyttja	"
7.	SR-3	<u>560 ± 100</u>	1390 AD	Beira, Mocambique	Recession of coastal lagoon	Wood	11
8.	SR-5	<u>750 ± 100</u>	1200 AD	Wonderboom, Pretoria	Wood from heart of tree	Wood	"
9.	SR-4	<u>350 ± 100</u>	1600 AD	"	Wood from 6' from heart of tree	"	"

b. CENTRAL AFRICA

10.	L-349B	<u>14,000 ± 600</u>	12,050 BC	Lake Kivu, Congo	Old shoreline	Shells	3
11.	L-349A	<u>12,450 ± 350</u>	10,500 BC	Lake Kivu, Ruanda	100m terrace above lake	"	"
12.	Lv-17	<u>7840 ± 190</u>	5890 BC	Lemba, Congo	Dates time when present desert was Equatorial forest	Fossil wood	13
13.	SR-24	<u>1930 ± 100</u>	AD 20	Situmpa Forest Zambia	Useful for dating of Kalahari sands	Charcoal	12
14.	SR-2	<u>1010 ± 100</u>	AD 940	Lake Kariba, Baobab tree	Heart of baobab tree of 15' diameter	Wood	11
15.	SR-1	<u>740 ± 100</u>	AD 1210	"	Midway between outside and centre of tree	"	"

c. EAST AFRICA

16.	I-556	<u>14,700 ± 290</u>	12,750 BC	Mahoma Lake, Uganda	Minimum date for glacial retreat	Gyttja	8
17.	NPL-54	<u>12,890 ± 130</u>	10,940 BC	Muchoya Fen, Uganda	To correlate climatic sequence in NW Europe and E Africa	Peat	10
18.	NPL-53	<u>9340 ± 100</u>	7390 BC	"	"	"	"
19.	NPL-52	<u>6570 ± 95</u>	4620 BC	"	"	"	"
20.	Y-568	<u>7530 ± 450</u>	5580 BC	Dura River, Uganda	70'-100' old level of Lake George	Carbonized Wood	5

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c. EAST AFRICA (cont.)

Lab. No.	Date <u>B. P.</u> B. C.	Site	Associations	Sample	Reference
21. Y-611	Modern	Dwemkorebe River Uganda	Sample contaminated	Peaty material	5
22. Y-688	3720 ± 120 1770 BC	Hippo Bay Cave, Uganda	Dates last high shoreline of Lake Victoria	Charcoal	"
23. W-749	480 ± 200 AD 1470	Kibwezi, Kenya	From beneath a lava flow around a spring	Charcoal	7

d. WEST AFRICA

24. U-266	950 ± 70 AD 1000	Abidjan, Ivory Coast	Beach 48m above salt water lagoon	Shell	14
25. U-265	990 ± 70 AD 960	"	"	"	"
26. U-264	970 ± 110 AD 980	"	"	"	"
27. T-340B	$21,350 \pm 350$ 19,400 BC	Fachi, Niger	Old level of ancient Lake Chad	Lacustrine limestone	15
28. T-280	9150 ± 200 7200 BC	Bouloum Gana, Niger	"	Diatomite	"
29. T-338A	8580 ± 110 6630 BC	Agadem, Niger	"	"	"
30. T-338B	9240 ± 130 7290 BC	"	"	"	"
31. T-341	7000 ± 100 5050 BC	Kafra, Niger	"	Limestone	"
32. T-361	7310 ± 120 5360 BC	Adrar Bous, Niger	"	"	"
33. T-279	6900 ± 150 4950 BC	Kandel Bouzou Niger	"	Carbonized organic fragments	"

e. ISLANDS

34. Q-417	4720 ± 130 2770 BC	Albatross Plain, Gough Island	Vegetation pattern very uniform over last 4700 years	Peat	6
35. Q-418	2345 ± 120 395 BC	"	"	"	"
36. GaK-277	2250 ± 420 300 BC	Baie des Galions, Madagascar	Wave cut notch at 1.4m above sea level	Shell	16

ADDITIONAL NOTES ON GEOLOGICAL AND TREE RING DATES

1. **W-246. Cape Flats, South Africa**

> 38,000

Charcoal from under 35-40 feet of sand resting on clay in the Cape Flats. The geologic history of the Cape Flats is uncertain, and the date has a bearing on whether the Cape Flats was a shallow straits recently or whether the sand was windblown. Collected by S.S. Amdurer, University of Cape Town (1). Results have not yet been published.

2. **Y-49. Cape Flats, South Africa**

> 38,000

Podocarp wood from 20' below the surface of a sandy deposit forming part of the Cape Flats, the low-lying area separating the Cape Peninsula from the mainland. Submitted by the South African Museum, Cape Town. (2)

3. **Y-106. Crawford, Cape Province, South Africa**

> 36,300

Podocarp wood from 27' below the surface of a 70' terrace (17) forming part of the Cape Flats. **Comment:** The terrace is probably older than the last interglacial age. The two measurements (Y-49 and Y-106) cast no doubt on the supposition that the wood belongs to the terrace, but do not provide an adequate date for the last separation of the Cape Peninsula from the mainland. (2)

4. **Y-468. Sedgefield, Knysna, South Africa**37,700 ± 2000

35,750 BC

Marine shells from a beach ca. 4m above sea level (4m above top of marine layer at Groenvlei, bracketed between dates of 6870 and 1905 BP - this list no. 5 and 6), buried below a flat sandy plain, believed to be formed sub-aerially, whose surface forms a terrace at Sedgefield (34°01'S; 22°48'E), 2 miles west of Groenvlei and about 2 miles inland from the present coast. Upper sandy portion of the section contains a red cemented band, thought to be part of a fossil soil and postdating the shells; shells include *Calliostoma fultoni*, not now living south of Delagoa Bay, 8° of latitude further north, and *Cerithium kochi*, and Indo-Pacific species of similar implication, though still found at Algoa Bay, about 180 miles east and 1° of latitude further north of Sedgefield. Collected in 1956 and submitted by A.R.H. Martin, University of Sydney, Australia.

Comment: Shell bed is thought to belong to an older, higher sealevel than that recorded at Groenvlei. *Calliostoma fultoni* is recorded from a similar beach at Klein Brak River, 40 miles west where it was regarded as evidence of a post-glacial hypsithermal interval, or as Last Interglacial. Older, higher marine features in the district, recording a sealevel at least 7 or 8 m above the present one, belong to a group commonly thought to be of last interglacial (Monastirian II) age. Features at 4 to 5 m above present sealevel, including the dated beach at Sedgefield, were ascribed by Krige to a "resting stage in the last emergence", and may belong to the Epimonastirian of Zeuner, which may date from the interval between Early and Main Wurm. The date and the geomorphic evidence of youthfulness favor such an assignment, but the climatic implications of the shells

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(sea-surface temperatures about 5°C higher than today's) does not. A postglacial date is clearly ruled out, and there is no evidence of a postglacial sealevel more than 1.5m above the present one in the Knysna district. The possibility of slight contamination of the shells by modern (atmospheric) C14, always present when very old carbonate is used for dating, makes it impossible to be sure that the Sedgefield deposit is not beyond the limit of C14 dating, and therefore probably of last interglacial (Eemian) age; but the shells were not exposed to air until collection, and contamination is not particularly likely. (9, 18, 19, 20).

Groenvlei series, South Africa

Peat and gyttja from fen deposits at Groenvlei (33°48'S, 22°52'E), a coastal lagoon in the Knysna division, South Africa. Borings show marine mud intercalated in the freshwater deposits, beginning at 5.8m below the surface of the fen (about 3m below mean sealevel), and grading upward into brackish water and then to freshwater deposits. Brackish water diatoms have their maximum appearance at 3.6m below the fen surface, and a fully freshwater diatom assemblage was re-established by 1.7m. Pollen analysis shows that heath vegetation predominated from the beginning of deposition until the return to freshwater conditions commenced. Collected 1956 and submitted by A.R.H. Martin, University of Sydney, Australia. (4, 18, 19, 20).

5. Y-466 Groenvlei, lower freshwater layer

6870 ± 160
4920 BC

Humified freshwater peat from three 10cm portions of a 30cm core, collected by a Hiller borer immediately below the level of marine mud at 5.8m below the fen surface. (4)

6. Y-467 Groenvlei, upper freshwater layer

1905 ± 60
45 AD

Gyttja from 2.9m below the fen surface overlying marine and brackish water deposits; collected by post-hole auger. **Comment:** The marine incursion, which never seems to have reached a higher level than that of today's, is bracketed between the age of the Boreal-Atlantic transition and the beginning of the sub-Atlantic time in Europe. (4)

7. SR-3 Estoril Beach Camp, Beira, Mozambique

560 ± 100
AD 1390

Wood of *Avicennia marina* found 2 miles north of the Estoril Beach Camp (19°45'S, 35°0'E). Wood was imbedded in lagoon mud and had been exposed by coastal erosion. Collected by A. D. Boughey, U.C.R.N., Salisbury. **Comment:** By analogy with the relationship between the existing coastline and the present lagoon, date gives an estimate of the time taken by this stretch of coast to overrun the lagoon in which this tree once grew. (11)

8. SR-5 Wonderboom, Pretoria

750 ± 100
AD 1200

Wood sample taken five ft. from the heart of the tree known as the Wonderboom (*Ficus pretoriae* Burt-Davey) (25°36'S; 28°12'E). Collected by J. E.

Repton, submitted by H. Bruuns-Lich, Parks and Recreation Dept., Pretoria. (11)

9. **SR-4 Wonderboom, Pretoria** 350 ± 100
1600 AD

Wood taken 6ft. from the heart of the same tree as SR-5. **Comment:** Because of the enormous size of the Wonderboom its age has long been a considerable source of interest. In the absence of any extant heartwood, the age of the tree is estimated, on the basis of the above dates and the existing size of the tree, to be about 1000 years. (11)

10. **L-349B Lake Kivu, Belgian Congo** $14,000 \pm 600$
12,050 BC

Lamellibranch shells from Kiritshe beach, Belgian Congo ($1^{\circ}36'S$; $29^{\circ}02'E$) at the northwest corner of Lake Kivu. Originally it was thought that the shells should be modern, but the old radiocarbon age is considered consistent with two facts pointing to the shells being ancient: (i) no living lamellibranch molluscs have been found in the vicinity. and (ii) excavated pits in the area show a nearly continuous buried shell layer. Thus the shell age probably dates a former level of the lake close to the present level. Lake Kivu must have passed the present level before reaching the high level dated by sample L-349A. Collected in 1955 by A. Meyer; submitted by the Director of the Geological Survey of the Belgian Congo. **Comment:** The age is based on an initial C14/C12 ration equal to that in atmospheric CO_2 and hence must be considered maximum. (3)

11. **L-349A Lake Kivu, Ruanda** $12,450 \pm 350$
10,500 BC

Shells from a terrace 330' (100m) above the level of Lake Kivu at Kisenyi ($1^{\circ}42'S$; $29^{\circ}16'E$), Ruanda. Sample was imbedded in a sandy-clay bed inter-stratified with coarse sand and volcanic ash at the former mouth of the Sebeya stream. Apparently the shells date a high level of the lake. Collected 1955 by A. Meyer and submitted by the Director of the Geological Survey of the Belgian Congo. (3)

12. **Lv-17 Lemba, Congo** 7840 ± 190
5890 BC

Fossil wood from dried-out fen, collected during construction of a road at Lemba ($4^{\circ}23'S$; $15^{\circ}20'E$), Province of Leopoldville. Collected 1957 and submitted by W. Van Pée, Louvanium University, Leopoldville. **Comment:** Date indicates a time when the site, presently a desert, was occupied by equatorial forest (13). Details of the type of wood, etc. are not yet published.

13. **SR-24 Situmpa Forest Station, Zambia** 1930 ± 100
AD 20

Charcoal sample from charcoal levels in the Kalahari sand at a depth of 42 ins. Geographical position: $16^{\circ}50'S$; $25^{\circ}07'E$. Submitted by B. Fagan, Rhodes-Livingstone Museum, Zambia. **Comment:** Sample is of stratigraphical importance over some distance and ties in with sample C-829 (see Iron Age list)

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(12), but details of its implication have not yet been published.

14. **SR-2 Baobab Tree heartwood, Lake Kariba** 1010 $\pm$ 100
940 AD

Wood from the heart of tree *Adonsonia digitata* L. from bush-clearing operations at Lake Kariba (16° 55'S; 28° 05'E), in Rhodesia. **Comment:** Since many Baobab trees grow to a diameter greater than 20 ft. the indications are that many of them are more than 1000 years old. (11)

15. **SR-1 Baobab Tree** 740 $\pm$ 100
AD 1210

Wood sample from same tree as above, taken from midway between the centre and the outside of its 15 ft. diameter. Collected and submitted by E. Swart. (11)

16. **I-556 Mahoma Lake, Uganda** 14,700 $\pm$ 290
12,750 BC

Gyttja from Mahoma Lake (0° 21'N; 29° 58'E), altitude 3000m, the lowest glacial lake in the Ruwenzori range. Sample from 5.2 to 5.4m depth in lake sediment at a station in 0.5m of water. Collected 1960 and submitted 1962 by D.A. Livingstone, Duke University, Durham, North Carolina U.S.A. **Comment:** Date is a minimum for and probably close to the true age of the glacial retreat from the lowest valley moraines. This is the first known direct dating of any glacial event in equatorial Africa, and indicates that retreat from the last glacial maximum was synchronous with that in the temperate zone. (8, 21)

Muchoya Fen series, Uganda

Peat, separate cores from a Hiller drill, from Muchoya Fen, 8000 ft. above sealevel within Echuya Central Forest Reserve (1° 30'S; 30°E). Collected 1960 and submitted by M. E. S. Morrison, Makerere University College, Uganda. (10)

17. **NPL-54 Muchoya Fen, depth 750-800 cm** 12,890 $\pm$ 130
10,940 BC
18. **NPL-53 Muchoya Fen, depth 600-650 cm** 9340 $\pm$ 100
7390 BC
19. **NPL-52 Muchoya Fen, depth 400-450 cm** 6570 $\pm$ 95
4620 BC

General comment: The fen, within the area of Bufumbira volcanic bay, is in the equatorial belt and enjoys a somewhat temperate climate throughout the year. The profile was analysed at consecutive small vertical intervals for its pollen content. Results should be important in correlation of late Quaternary climatic and vegetation sequences in NW Europe and equatorial East Africa. (10, 22)

Dura River series, Uganda

Carbonized wood and peaty material imbedded in and overlain by travertine limestones, exposed in the valley of the Dura River (0° 12'N; 30° 18'E) and its tributary the Dwemkorebe River, western Uganda. The travertines occur inter-

bedded with apparently lacustrine limestones, laid down when the level of Lake George in this region stood 70 to 100 ft. above its present altitude of 2997 ft. above O.D. (23). The deposits, with maximum observed thickness of 50 ft. overlie fluvio-lacustrine gravel. Collected 1957 by R. Seal; submitted by W.W. Bishop, Geological Survey of Uganda (10).

20. **Y-568 Dura River** 7530 $\pm$ 450
5580 BC

Carbonized wood imbedded in travertine, collected from a spoil dump near the main outcrop where the limestones attain maximum observed thickness (5).

21. **Y-611 Dwemkorebe River** Modern

Carbonized wood and peaty material from below the limestone, occurring along the Dwemkorebe valley. **Comment:** If the limestones were in part lacustrine, a relative upwarp of 40 to 50 ft. must have taken place since their formation as there is firm evidence south-west of Lake George that the lake was within 30 ft. of its present level prior to the deposition of the Katwe volcanic ash, dated by de Heinzelin (24) at about 8000 years B. P. The ash is post-dated by local faults and hence comparatively recent tectonic activity is confirmed for the region. However, it is possible that in addition to the travertine much of the limestone arises from subaerial spring action (5).

22. **Y-688 Hippo Bay Cave, Entebbe, Uganda** 3720 $\pm$ 120
1770 BC

Charcoal from a lens of sand 9 ins. thick, interpreted as part of an emerged beach. Stratigraphic succession shows a wave-cut platform of lateritic ironstone at the base, the lens of sand dated, a 1-2 ins. gravel layer and then pottery-rich occupation layers in a small cave on the western headland of Hippo Bay (0° 03'N; 32° 27'E), at an altitude of 8 ft. above Lake Victoria (25). The charcoal is presumably indicative of human activity but has been rounded by wave action: it dates the last and lowest former high shoreline (ca. 12 ft. above lake level) of Lake Victoria (26); the high lake level is considered not to have resulted from crustal movement, but probably marks a stillstand in down-cutting of the lake outlet at Jinja. Collected in 1957 and submitted by W.W. Bishop, Geological Survey of Uganda (5).

23. **W-749 Kibwezi, Kenya** 480 $\pm$ 200
AD 1470

Charcoal from near Kibwezi, 120 miles south-east of Nairobi (2° 30'S, 38° 10'E). From beneath a lava flow and above a limestone deposited around a spring. Collected 1957 by R. G. Dodson, submitted by A. O. Thompson, Mines and Geological Dept., Nairobi. (7)

24. **U-266 Abidjan, Ivory Coast** 950 $\pm$ 70
AD 1000

Salt water lagoon mollusc shells, accumulated by wave action, from Adiopodioume, Abidjan (5° 10'N; 3° 50'W), Ivory Coast. Sample from a 50 cm thick layer of shells, at an altitude of 48m. Collected 1960 and submitted by

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J. Tricart, University of Strasbourg, France. This dates the inner 17% of the sample (14). Wave action at this altitude appears anomalous.

25. U-265 Abidjan, Ivory Coast 990 ± 70
AD 960

This dates the layer corresponding to 34% of the shells. (14)

26. U-264 Abidjan, Ivory Coast 970 ± 110
AD 980

Outer layer of shells corresponding to 42%. (14)

Niger Series

Lacustrine sediments in areas of East Niger now deserts, have been correlated with a long humid period in the Quaternary; an immense Lake Chad covered a large part of Niger, from Tenere desert in the south-east towards the present Lake Chad. Sediments are between ancient dunes of sand and more recent eolian sands. Six C14 dates from these sediments, all collected 1954-1962 and submitted by H. Faure, University of Dakar, show that the end of the lacustrine period was probably ca. 7000 years B.P. The dates indicate that humid periods in the Sahara do not necessarily correspond to European Ice Ages (15, 27).

27. T-340 B Fachi, Niger 21,350 ± 350
19,400 BC

Lacustrine limestone from Fachi (18° 03'N; 11° 40'E), underlying a layer of diatomite. Limestone was impure with *Phragmites*. **Comment:** Date may correspond to a low stratigraphic horizon. Assuming rate of sedimentation to be 3 to 5m of diatomite in 10,000 to 15,000 years, the sample could belong to the same lacustrine period as the others. The date does not, however, indicate the beginning of this period, as diatomite underlies the dated layer. (15)

28. T-280 Bouloum Gana, East Niger 9150 ± 200
7200 BC

Diatomite from Bouloum Gana (15° 01'N; 10° 37'E), from a well at an altitude of 390m, from a sequence of lacustrine sediments. (15)

29. T-338 A Agadem, East Niger 8580 ± 110
6630 BC

Pure diatomite from the principal layer in a lacustrine deposit of clay or mud, locally mixed with limestone containing numerous silicified stems of *Phragmites*. Geographical position: 16° 50'N; 13° 20'E. (15)

30. T-338 B Agadem, East Niger 9240 ± 130
7290 BC

Impure diatomite imbedded in mud from a lower position than T-338 A.

(15)

31. T-341 Kafra, East Niger 7000 ± 100
5050 BC

Lacustrine limestone from Kafra (18° 59'N; 12° 20'E), with *Phragmites*.

Comment: Probably represents the end of the lacustrine period. See also comment of T-361. (15)

32. T-361 Adrar Bous, East Niger

7310 ± 120

5360 BC

Lacustrine limestone from Adrar Bous ($20^{\circ} 18'N$; $09^{\circ} 02'E$), altitude 700m. As the sediments here have a difference of altitude of more than 300m from those of the eastern part of Tenere Fachi, there may have been separate lakes in this district. **Comment:** The date is close to that of T-341 and in these two cases limestone represents the last lacustrine sediments overlying diatomites. Dates thus probably mark the end of the humid period in the south and central Sahara. (15).

33. T-279 Kandel Bouzou, East Niger

6900 ± 150

4950 BC

Carbonized organic fragments (moss and water plants) from Kandel Bouzou ($15^{\circ} 24'N$; $10^{\circ} 59'E$), found in black sandy mud, altitude 385m, probably a former bog beneath sand with Neolithic pottery. **Comment:** Date may indicate the end of a great humid period; it agrees with that of the inorganic carbonates (T-361 and T-341). (15)

34. Q-417 Albatross Plain, Gough Island. 213-218cm

4720 ± 130

2770 BC

Sphagnum-*Cyperaceae*-*Empetrum* peat ($40^{\circ} 20'S$; $10^{\circ}W$), at the base of a pollen analyzed series and situated immediately over bedrock. Collected 1957 by N. M. Wace and M. Holdgate. **Comment:** This date in conjunction with the pollen analyses establishes a remarkably uniform vegetation for the past 4700 years. (6)

35. Q-418 Albatross Plain, Gough Island. 180-184 cm

2345 ± 120

395 BC

Peat enclosing a thin layer of volcanic ash, from the same boring as Q-417. **Comment:** This establishes a date for a volcanic eruption on the island (possibly the latest); the 40 cm of peat between the two samples would seem to represent as long a time period as the 180 cm formed after Q-417 was deposited. (6)

36. GaK-277 Baie des Galions, Madagascar

2250 ± 420

300 BC

Shell from a wave-cut notch at Baie des Galions ($25^{\circ} 30'S$; $46^{\circ} 30'E$). The notch is 1 to 1.4 m above the similar notch corresponding to present sealevel. Collected 1957 and submitted by R. Battistini, University of Madagascar.

Comment: Dates the period in which sealevel was 1 to 1.4 m higher than the present level. Similar notches are frequent on the south and west coasts of Madagascar. (16, 28)

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B. ARCHAEOLOGICAL DATES

I. Early Stone Age and First Intermediate

a. SOUTH AFRICA

no dates

b. CENTRAL AFRICA

Lab. No.	Date $\frac{B.P.}{B.C.}$	Site	Associations	Sample	Reference
1. GrN-2644	$57,600 \pm 750$ 55,650 BC	Kalambo Falls, Zambia	Late Acheulian	Wood	1
2. GrN-1396	> 52,000	"	"	"	"
3. GrN-3211	> 49,000	"	Lowest Sangoan	"	"
4. GrN-3226	$46,100 \pm 3500$ $44,150 \pm 2400$ 44,150 BC	"	"	Charcoal	"
5. L-399C	$43,000 \pm 3300$ 41,050 BC	"	Sangoan	Wood	3
6. L-399B	> 42,500	"	"	"	"
7. GrN-3237	$42,000 \pm 2000$ 40,050 BC	"	?Middle to Lower Sangoan	"	1
8. L-399A	> 40,000	"	Sangoan	"	3
9. GrN-3196	$40,600 \pm 1300$ 38,650 BC	"	Later Sangoan	Charcoal	1
10. GrN-3228	$37,900 \pm 1500$ $35,950 \pm 1200$ 35,950 BC	"	Probably Sangoan	Wood	"
11. L-271A	> 35,000	"	Acheulian	"	2
12. GrN-3608	> 32,600	"	Sangoan	Charcoal	1
13. SR-7	> 42,200	Pomongwe, Rhodesia	Sangoan	"	9
14. SR-8	$42,200 \pm 2300$ 40,300 BC	"	Proto-Stillbay	"	"

c. EAST AFRICA

No Carbon-14 dates. See Cole, S. 1964. *The Prehistory of East Africa*. George Weidenfeld & Nicholson. 117-126 for Potassium - Argon dates and their associations at Olduvai Gorge. Also Leakey, L.S.B., Evernden, J.F. & Curtis, G.H. 1961. The Age of Bed I, Olduvai Gorge, Tanganyika. *Nature* 191, 478.

d. WEST AFRICA

15. Y-142-8	> 39,000	Nok, Nigeria	Acheulian	Carbonized wood	7
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ADDITIONAL NOTES ON EARLY STONE AGE AND FIRST
INTERMEDIATE DATES**Kalambo Falls:**

Kalambo Falls are at the south eastern end of Lake Tanganyika on the territorial boundary between Northern Rhodesia and Tanganyika. In a small basin above the falls are three main series of sediments forming three terrace features at ca. 20m, 10m, and ca. 5m above the river. These contain a nearly continuous cultural sequence from the end of the Earlier Stone Age (Late Acheulian) up to the present day. Excavations have been carried out since 1953 by J. D. Clark of Rhodes-Livingstone Museum, now of the Dept. Anthropology, University of California, Berkeley, and have exposed a series of well-stratified living floors, stream, lake and swamp sediments, and erosion surfaces with a wealth of associated cultural remains (Clark, 4, 5, 6). Oldest surfaces and floors contain wooden as well as stone artifacts and evidence of fire-using. E. M. van Zinderen Bakker was able to detect in the pollen climatic variations which represent a pre-Gamblian wet period (Late Kanjeran), the Gamblian, and the Holocene. C14 dates indicate that the time span involved is from early Wurm onwards. (See refs. 1, 2, 3, 4, 5, 6, 10, 11).

1, 2 GrN-2644, GrN-1396. Kalambo Falls /57. $57,600 \pm 750$
55,650 BC

A log of well-preserved wood from Floor 6 at site A 1, 6.7m below surface, and associated with a late Acheulian industry (handaxes, cleavers and flake tools) which preceded the Sangoan at this site. **Comment:** C14 in sample GrN-2644 was enriched by a factor of 8.7 before measurement, and the finite date was obtained, while sample GrN-1396 was from the same log but was not enriched. (1)

3. GrN-3211. Kalambo Falls 26/59R > 49,000

Wood immediately over lower clay layers and from lowest Sangoan level in trench A4. **Comment:** Date appears old for Sangoan and it is possible that wood might have been derived from clays on which it was lying and which in the 1963 excavations at Site A were associated with a transitional Acheulian-Sangoan industry. (1)

4. GrN-3226. Kalambo Falls 16/59R $46,100 \pm 3500$
44,150 BC

Small sample of charcoal below clay bank in fine white sand in Trench A4, representing the later stages of the typical Sangoan. (1)

5. L-399C Kalambo Falls $43,000 \pm 3300$
41,050 BC

Wood from beneath the third occupation floor i.e. under the Middle Stone Age occupation and over the Early Stone Age layers at Site A. Sample comes from

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the roots of a tree that apparently grew on a land surface developed on the lower levels of the Early Stone Age beds after the upper levels had been removed by erosion. The tree was then buried by material upon which the third or Middle Stone Age floor developed. The sample is believed to date the time of the Sangoan culture. Laboratory recommends that this date be used in a conservative manner due to methods used in counting. (3)

6. **L-399B. Kalambo Falls** > 42,500

Wood from the fourth occupation floor at Site B. Associated cultural material was sparse but sufficient (in the form of picks) to be sure that it is post-Chelles-Acheul and belongs with the Sangoan. (3)

7. **GrN-3237. Kalambo Falls 8/59R** $\frac{42,000 \pm 2000}{40,050 \text{ BC}}$

Wood fragments in sterile lower coarse sand 2.3m under main (Middle Stone Age) erosion surface at site B2. Sangoan artifacts (middle to lower stages?) occur sporadically in gravel stringers at this depth. (1)

8. **L-399A. Kalambo Falls** > 40,000

Wood from a clay-filled gully cut in current-bedded sands and believed to be of approximately the same age as samples L-399B and L-399C. (3)

9. **GrN-3196. Kalambo Falls 11/59R** $\frac{40,600 \pm 1300}{38,650 \text{ BC}}$

Charcoal flecks and small fragments in gray sand 15cm below main (Middle Stone Age) stone line in Trench A4 representing later stages of typical Sangoan Culture. Pollen evidence indicates climate was cooler and wetter than in the immediately following stages. (1)

10. **GrN-3228. Kalambo Falls 5/59R** $\frac{+ 1500}{37,900 \pm 1200}$
35,950 BC

Small sample of wood in coarse sand 1.5m under main (Middle Stone Age) stone line and over gravel stringer containing Sangoan waste. Since Sangoan sediments are characterized by much cutting and filling and culture is conservative, it is difficult to correlate the succession on the different sites. (1)

11. **L-271A. Kalambo Falls** > 35,000

Wood from a tree trunk found in Lower Palaeolithic site, later (3) referred to as being from Floor 5 (Acheulian). (2)

12. **GrN-3608. Kalambo Falls 18/59R** > 32,600

Small sample of charcoals 4m below clay bank in Trench A4 from dark grey clay containing Sangoan artifacts. (1)

13. **SR-7. Pomongwe, Rhodesia** > 42,200

Pomongwe Cave in the Matopos Hills was excavated during 1960-1961 by C.K. Cooke, Director of the Historical Monuments Commission in Rhodesia. Geographical position: 20° 32'S Lat., 28° 30'E Long.

For sample SR-7, an exceptionally small charcoal sample had to be counted at reduced pressure. The cultural affinities are probably Sangoan. (8, 9)

14. SR-8. Pomongwe, Rhodesia

$42,200 \pm 2300$
40,300 BC

Combination of two charcoal samples. **Comment:** mixing was necessary because of the small amount of charcoal in the deposit. Stratigraphically the samples were one below the other but culturally the same, being the nexus between the Sangoan of the 1st Intermediate Stone Age and the Still Bay of the Middle Stone Age. In his report on the excavations, Cooke (1963) refers to this sample as dating the Proto-Stillbay. (8, 9)

Note: The B. C. date given above and in the table is that published by the laboratory and is not consistent with general practise of subtracting 1950 from the B. P. date. A corrected figure would read 40,250 B. C.

15. Y-142-8. Nok, Nigeria.

> 39,000

Carbonized wood from Nok E, the oldest alluvium, and associated with Acheulian artefacts. Collected by Bernard Fagg. (7)

REFERENCES FOR EARLY STONE AGE AND FIRST
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II. MIDDLE STONE AGE AND SECOND INTERMEDIATE

a. SOUTH AFRICA

Lab. No.	Date	B. P. B. C.	Site	Associations	Sample	Reference
1. Y-103	> 44,000		Florisbad, Orange Free State	Peat I. Level of Florisbad skull	Peat	3
2. C-850	> 41,000		"	"	"	2
3. L-271B	> 35,000		"	"	"	1
4. L-271C	<u>28,450 ± 2200</u> 26,500 BC		"	Peat II. Middle Stone Age	"	"
5. L-271D	<u>19,530 ± 650</u> 17,580 BC		"	Peat III. Middle Stone Age	"	"
? 6. C-851	<u>9104 ± 420</u> 7154 BC		"	Peat II. Middle Stone Age	"	2
? 7. C-852	<u>6700 ± 500</u> 4750 BC		"	Peat III. Middle Stone Age	"	"
? 8. BM-39	> 25,000		Olieboompoort, Transvaal	Middle Stone Age, Pietersburg variant	?Charcoal or decayed wood	4
* 9. C-926	<u>16,811 ± 960</u> 14,861 BC		Cave of Hearths, Transvaal	Earlier Pieters- burg	Organic material	2
*10. C-927	<u>11,700 ± 610</u> 9,750 BC		"	"	"	"
*11. C-924	<u>11,600 ± 700</u> 9,650 BC		"	Middle Pieters- burg	"	"
*12. C-925	<u>15,100 ± 730</u> 13,150 BC		"	Later Pieters- burg	"	"
13. BM-30	<u>18,200 ± 500</u> 16,250 BC		Holley Shelter Natal	Middle Stone Age from 24"-30"	Charcoal	4
14. BM-34	<u>4,490 ± 150</u> 2,540 BC		"	" from 18"-24"	"	"

b. CENTRAL AFRICA

15. UCLA-168	<u>38,000 ± 2500</u> 36,050 BC		Mufo Mine, Angola	Sangoan/Lower Lupemban	Peat	7
16. UCLA-169	> 34,000		"	"	Wood	"
17. C-581	<u>14,503 ± 560</u> 12,553 BC		"	Later Upper Lupemban or Lupemban-Tshitolian	Carbonized Wood	8
18. C-580	<u>11,189 ± 490</u> 9,239 BC		Mufo Mine, Angola	Lupembo-Tshitolian or Lower Tshitolian	Carbonized Wood	8
19. SR-9	<u>42,200 ± 2300</u> 40,250 BC		Pomongwe, Rhodesia	Early Stillbay or ?Proto-Stillbay	Charcoal	9
20. SR-39	<u>35,530 ± 780</u> 33,580 BC		"	Stillbay or ?Proto-Stillbay	"	"
21. SR-10	<u>21,700 ± 400</u> 19,750 BC		"	Stillbay	"	"
22. SR-11	<u>15,800 ± 200</u> 13,850 BC		"	Magosian	"	"

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b. CENTRAL AFRICA (cont.)

Lab. No.	Date	B. P. B. C.	Site	Associations	Sample	Reference
23. Lv-44	> 30,000		Lemba, Congo	Below Late Lupemban level	Fossilized Wood	6
24. Lv-47	> 30,000		Basoko R. Congo	Lupemban	Charcoal	"
25. L-399 I	$30,500 \pm 2000$ $28,550$ BC $27,500 \pm 2300$ $25,550$ BC		Kalambo Falls, Zambia	Rhodesian Lupemban	"	5
26. UCLA-229	$22,800 \pm 1000$ $20,850$ BC		Twin Rivers, Zambia	Middle Stone Age	Travertine	10
27. L-395 D	$9,550 \pm 210$ $7,600$ BC		Abercorn, Zambia	Rhodesian Magosian	Charcoal	5

c. EAST AFRICA

28. NPL-38	$31,480 \pm 1640$ $29,530$ BC		Kisese, Tanzania	2nd Intermediate	Charred Ostrich eggshell	29
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d. WEST AFRICA

29. Y-142-3	5575 ± 65 3625 BC		Nok C Nigeria	Middle Stone Age	Wood	3
30. Y-142-7	5440 ± 110 3490 BC		Zencbi Nigeria	" " "	"	"

ADDITIONAL NOTES ON MIDDLE STONE AGE AND SECOND
INTERMEDIATE DATES

Florissbad series, Orange Free State, South Africa:

Florissbad (28° 40'S; 26° 10'E) lies approximately 25-30 miles north of Bloemfontein. The stratification is marked with four so-called peaty layers separated by lighter bands of sand and clays. The dark layers are composed of blackish clays and sands with little organic matter (16).

Peat I: lies immediately over bedrock at a depth of 19 ft. and from it were recovered the Florissbad skull, *Homo* or *Africanthropus helmei*, in association with stone implements made in dolerite and extinct fauna including *Homoioceras bairdi* and *Equus helmei*.

Peat II: 47 ins. above Peat I and 13 ins. thick. Cultural material in lydianite is Middle Stone Age.

Peat III: 52 ins. above Peat II. Similar cultural material.

Peat IV: 23 ins. below the top layer of light grey sand.

The cultural affinities of the dolerite implements from Peat I are not very clear. Meiring (11) has suggested they be known as the Florissbad Chopper Culture, while Oakley (12) and others have referred to the assemblage as the Hagenstaad variant of the Middle Stone Age. The cultural material from the other levels (in lydiarite) is generally accepted as being Middle Stone Age of the Mazelspoort variant (13, 14, 15). Part of a wooden implement has been recovered from Peat I (13). Van Zinderen Bakker (16) has examined the deposits for pollens, but these have not been preserved at all levels and the evidence is incomplete.

Van Zinderen Bakker (16) has suggested that methane gas and underlying Ecca coal seams may be responsible for contaminating the peat used for dating samples and giving erroneously old dates, a view supported by Coon (17). However, contamination by old carbon produces a less significant error in an already old sample than does young carbon. Zeuner (18) shows that with a sample of the age of 37,000 years old, as much as 100 per cent old or inactive carbon would have to be added to make the date 5000 years older.

Note: After measurements C-581 and C-582 were made, the samples were found to have been contaminated with modern tree roots (11) and additional samples L-271C and L-271D were therefore submitted.

- | | | |
|----|---|----------|
| 1. | Y-103. Florissbad Peat I | > 44,000 |
| | Peat collected in 1951 and submitted by E. M. van Zinderen Bakker (3). | |
| 2. | C-850. Florissbad Peat I | > 41,000 |
| | Peat submitted by H. L. Movius Jr. on behalf of A. C. Hoffman, National Museum, Bloemfontein. (2) | |
| 3. | L-271B. Florissbad Peat I | > 35,000 |
| | Peat submitted by H. L. Movius Jr. on behalf of A. C. Hoffman, | |

Bloemfontein. (1)

4. L-271C. Florisbad Peat II

$28,450 \pm 2200$

26,500 BC

Peat from same level as sample C-851, but cleaned to remove modern tree rootlets. Submitted by H. L. Movius Jr. on behalf of A. C. Hoffman, Bloemfontein. (1)

5. L-271D. Florisbad Peat III

$19,530 \pm 650$

17,580 BC

Peat from same level as C-852, but pretreated to remove modern tree rootlets. Submitted as above. (1)

6. C-851. Florisbad Peat II

9104 ± 420

7154 BC

This sample is unreliable as it was later found to have been contaminated with younger carbon. Submitted as above. (2)

7. C-852. Florisbad Peat III

6700 ± 500

4750 BC

Sample unreliable due to contamination by younger carbon. Submitted as above. (2)

8. BM-39. Olieboompoort, Transvaal

> 25,000

The cave is on the west side of Olieboompoort, north-west of Waterberg in the Transvaal (23° 50'S; 27° 40'E) between Ellisras and Vaalwater villages. The sample of heavily mineralized material submitted for dating was recovered from Bed 2 in association with implements of the latter part of the Pietersburg Culture middle stage. Bed 2 overlies an Earlier Stone Age level (19) and underlies a Later Stone Age level of Later Smithfield type.

The sample of material submitted for dating occurred in nodules scattered between 36 in. and 54 in. below the present surface and therefore do not appear to represent a fireplace. The sample closely resembled charcoal, but nothing remained after treatment with hot 1% hydrochloric acid and hot 1% caustic soda. Accordingly, the caustic-soda-soluble fraction was reprecipitated with acid, washed and dried, and used as the source of carbon. Under these circumstances one cannot rule out the possibility of contamination (4). Collected during excavation by Dr. R. J. Mason. (See also (20)).

Note: This date has frequently been quoted as > 33,000 (19). The date published by the laboratory has been taken as the correct one.

Cave of Hearths, Transvaal.

The Cave of Hearths in the Makapansgat Valley near Potgietersrus in the Transvaal has revealed a long sequence of cultures associated with faunal material. Mason (19) has published the following succession from the excavated deposit which is some 40 ft. deep.

Beds 1-3: Earlier Stone Age, Acheulian culture

Bed 4: Middle Stone Age, Earlier Pietersburg culture

Bed 5: Middle Stone Age, Middle Pietersburg culture

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- Beds 6-9: Middle Stone Age, Later Pietersburg
- Bed 10: Later Stone Age, Smithfield culture
- Bed 11: Iron Age.

Anomalies in the following dates are difficult to explain and may be due to a variety of sources of contamination. Mason (19) states that one of the dates (C-927) comes from a subsided part of Bed 4, but its radiocarbon age is 5,000 years less than the *in situ* part of the same bed, while the Bed 5 date (C-924) is also about 5,000 years less than the Bed 6 date.

By statistical analysis of the Pietersburg cultural material from the Cave of Hearths, Mason (20) has been able to correlate other sites in the Transvaal with this sequence.

- 9. C-926. Cave of Hearths, Bed 4 16,811 ± 960
14,861 BC

Pietersburg culture Earlier stage from 156 ins. depth in Column "A". Organic material from the ashy substance constituting the deposit in the cave. (2)

- 10. C-927. Cave of Hearths, Bed 4 11,700 ± 610
9,750 BC

Earlier Pietersburg cultural stage. Sample same material as above, from 288 ins. depth in column "C". (2)

- 11. C-924. Cave of Hearths, Bed 5 11,600 ± 700
9,650 BC

Middle Pietersburg cultural stage. Sample same material as above, from 130 ins. depth in column "A".

- 12. C-925. Cave of Hearths, Bed 6 15,100 ± 730
13,150 BC

Later Pietersburg cultural stage. Sample same material as above from 180 ins. depth in column "B".

All samples collected by R.J. Mason and submitted by K.P. Oakley, British Museum, London.

Holley Shelter series, Wartburg, Natal

Two samples of charcoal from a rock shelter on the farm "Everdon" at Wartburg (29° 26'S; 30° 35'E), excavated by G. Cramb. The charcoal was collected from hearths which were quite close to each other both horizontally and vertically, the grids being 3 ft. square. The Middle Stone Age material is homogenous throughout and is overlain by Later Stone Age and Iron Age material in the top 6 ins. of deposit.

The close proximity of the samples makes the difference in their ages seem extraordinarily high. However, the excavator has pointed out that the situation of the cave is such that the build-up of the floor level may have been extremely slow. The value for BM-30 is not inconsistent with the Cave of Hearths Middle Stone Age date of 15,100 ± 730 (C-925). On the other hand, BM-34 is much too young by comparison and one must assume that either the sample is suspect or that the Middle Stone Age people lived uninterrupted in these parts to

a period more recent than has been thought. (4, 21)

13. **BM-30. Holley Shelter I** $18,200 \pm 500$
16,250 BC

Charcoal from the 24-30 ins. layer in Grid Z3.

14. **BM-34. Holley Shelter II** $4,490 \pm 150$
2,540 BC

Charcoal from the 18-24 ins. layer in Grid Z2.

Collected by G. Cramb, Durban, and submitted by the Director, Archaeological Survey.

Mufo Mine series, Lunda, Angola

Pleistocene deposits at Mufo, Angola, on the banks of the Luembe river ($7^{\circ} 38'S$; $21^{\circ} 24'E$) have yielded a succession of cultural material ranging from Earlier Stone Age on the $\approx 10m$ terrace, through Middle Stone Age Lupemban in the lower gravels of the $\approx 3m$ terrace and Lupembo-Tshitohian in the upper gravels of the same terrace. Later Stone Age Tshitohian implements occur either on top of the upper gravels or within the Redistributed Sands III which overlie the terrace. The deposits have been studied by Janmart (23), Leakey (24) and Clark (22).

There has been some change in the terminology used in this area in the past, and in 1957 Mortelmans (25) clearly defined and illustrated the industries and cultural terms for the region, and his terminology has been adopted by Clark (22, 26) and others.

15. **UCLA-168. Mufo Mine, Angola** $38,000 \pm 2500$
36,050 BC

Peat from the sand layer in the Lower Flats Gravel of the Flats Terrace at a depth of 10 ft. (7), and 3'6" below the top of the Lower Gravels of the 3-4m terrace (22). Middle Stone Age, Lower Lupemban culture (7), or Sangam-Lower Lupemban (22). Collected 1960 and submitted by J.D. Clark, Berkeley, California.

16. **UCLA-169. Mufo Mine, Angola** > 34,000

Wood from the sand layer near the base of the Lower Flats Gravel of the Flats Terrace at a depth of 15 ft. (7), and 3'6" below the top of the Lower Gravels of the 3-4m Terrace (22). Lower Lupemban (7), or Sangam-Lower Lupemban (22). Submitted as above.

17. **C-581. Mufo Mine, Angola** $14,503 \pm 560$
12,553 BC

Carbonized wood found 15cm down in the gravel underlying sample C-580 (8), and from the top-most 50cm of the Upper Gravels of the 3-4m Terrace (22). Submitted by J. Janmart, Museu do Dundo, Angola (8). Classified by Clark (26) as Later Lupemban (originally called Final Sangam by Janmart and Leakey) and later as Late Upper Lupemban or Lupembo-Tshitohian (22).

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18. C-580. Mufo Mine, Angola

11,189 ± 490
9,239 BC

Carbonized wood at the base of 2.50m of grey-white sand (=Redistributed Sand III of Clark (22)), associated with a Lupemban (=Tshitoliian of Mortelmans and Clark) backed blade (8), and from a land surface on the Upper Gravels of the 3-4m Terrace (22). The sample is placed uncertainly in this part of the list. Referred to by Janmart as Lupemban (=Tshitoliian), it was later placed in the "forest form of the Magosian" (=Lupembo-Tshitoliian) by Clark (26), and then in the Lupembo-Tshitoliian or Lower Tshitoliian by Clark (22). It may therefore be Later Stone Age.

Pomongwe series, Rhodesia

Pomongwe cave in the Matopo Hills (20° 32'S; 28° 30'E) near Bulawayo was excavated during 1960/61 by C.K. Cooke. Director of the Commission for the Preservation of Natural and Historical Monuments and Relics (9). In 13ft. 5 in. of deposit, the following cultural succession was recognized: Sangoan or Proto Stillbay, Stillbay, Magosian, an unusual scraper industry in a white ash layer, Wilton and Iron Age (Bambata ware) (27). Excavation of Tshangula cave nearby revealed a similar sequence.

19. SR-9. Pomongwe cave, Rhodesia

42,200 ± 2300
40,300 BC

Charcoal from small logs from hearths associated with the earliest levels of the Stillbay industry (9), from layer 6b E-g 6-8, at a depth of 8ft. 3 in. and at the contact of the lower cave earth (27). Owing to the early date for this sample and the 20,000 year hiatus between this and the developed stage of the Stillbay (SR-10), Cooke considers that this may be ?Proto-Stillbay (27).

Note: The BC date above is that published by the laboratory but it is not consistent with the practise of subtracting 1950 years from the BP date. A corrected figure would read 40,250 BC. See also the Early Stone Age list, date no. 13 and 14.

20. SR-39. Pomongwe cave, Rhodesia

35,530 ± 780
33,580 BC

Charcoal associated with the Stillbay industry (9). From layer 13, 5(2A) X-C 1-3 at a depth of 7ft. 6 in. and above the lower cave earth (27). Possibly of similar age to the above sample and also ?Proto-Stillbay.

21. SR-10. Pomongwe, Rhodesia

21,700 ± 400
19,750 BC

Charcoal associated with the developing Middle Stone Age Stillbay industry. The error is larger than usual because the sample was small and was counted at reduced pressure (9). From layer 5c E-G 6-8, and at a depth of 6ft. 6 in.

22. SR-11. Pomongwe, Rhodesia

15,800 ± 200
13,850 BC

Charcoal associated with the Second Intermediate Magosian industry (9).

From layer 4b I-K 6-8 at a depth of 3 ft. 9 in. (27). Cooke (27) considers that this unexpectedly early date "may well indicate that the introduction of the macrolith at this time was a spontaneous local invention and not an industry which was introduced by immigrant bands of Later Stone Age nomadic hunters from elsewhere."

Leopoldville series, Congo

Samples related to stone age industries in the Leopoldville plain.

Collected by H. V. Moorsel, Prehistorical Museum, Leopoldville, Congo, and submitted by F. Gullentops, University of Leuven, Belgium (6). The deposits have been compared with those from Angola by Clark (22a).

23. **Lv-44. Lemba, Congo** > 30,000

Fossil wood from Lemba ($4^{\circ} 23'S$; $15^{\circ} 20'E$) in peaty sandstone, the surface of which has a late Lupemban culture. Sandstone is covered by sand which has a Tshintorian culture (6). This sample therefore pre-dates the late Lupemban in this area.

24. **Lv-47. Basoko River, Congo** > 30,000

Charcoal from a site near the Basoko river on the Leopoldville plain ($4^{\circ} 21'S$, $15^{\circ} 17'E$). The sample is from a Lupemban horizon (intermediate zone) overlain by clayey silt and 30 cm above polymorphous sandstone blocks (6).

25. **L-399 I. Kalambo Falls, Zambia** $30,500 \pm 2000$ ¹ $27,500 \pm 2300$ ²
 $28,550$ BC $25,550$ BC

Charcoal from the earlier of two Middle Stone Age floors (Rhodesian Lupemban) in old lake beds adjacent to the falls, near the southern end of Lake Tanganyika. Collected by J. D. Clark, submitted by H. L. Movius Jr., (5) see also Early Stone Age list nos. 1-12.

¹ Residue after humic acid removal.

² Humic acid.

26. **UCLA-229. Twin Rivers, Zambia** $22,800 \pm 1000$
 $20,850$ BC

Travertine from a breccia-filled fissure, Twin Rivers ($15^{\circ} 31'S$; $28^{\circ} 11'E$). The fissures, some 2 to 6 ft. deep, occur on top of the Twin Rivers kopje and contain a Middle Stone Age industry and fauna. The Travertine is believed to have been formed as a result of the seepage of water down the slopes of the fissures during a cooler and wetter climate. The travertine sample dated was about 1 m. thick with a thin brown layer through the centre. The bottom and top halves of the sample were therefore dated and an average of the two calculated. The age of the top layer was $23,700 \pm 1000$ years, and that of the bottom layer $21,900 \pm 1000$ years, thus it appears that the C14 exchange subsequent to deposition has not been significant. Collected in 1956 and submitted by J. D. Clark (10). The industry is possibly Proto-Stillbay (26).

27. **L-395 D. Abercorn, Zambia** 9550 ± 210
 7600 BC

Charcoal from a temporary land surface near the base of a sequence of

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current-bedded sands ($8^{\circ}35'S$, $31^{\circ}13'E$). The sample should date the Rhodesian Magosian culture. Collected by J.D. Clark (5).

28. NPL-38. Kisese II Rock shelter, Tanzania $\frac{31,480 \pm 1640}{29,530 \text{ BC}}$

Charred ostrich eggshell was used to date this sample from the middle part of the Second Intermediate level in Kisese II Rock shelter ($4^{\circ}25'15"S$; $35^{\circ}50'E$) in the Kondo district of Tanzania. However, in view of the careful pretreatment given the samples, the suitability of ostrich eggshell for dating requires investigation (29). See Later Stone Age list nos. 38-40 for further dates and information.

29. Y-142-3. Nok C, Nigeria $\frac{5575 \pm 65}{3625 \text{ BC}}$

Wood from alluvium exposed in the Main Paddock of a tin mine on the Nok River near Jos. The oldest alluvium contains Acheulian artefacts, the next oldest (this sample) contains Middle Stone Age, and the basal gravel of the youngest alluvium contains pottery and terra-cotta figurines and some evidence of metal working. The sample was measured twice to insure against mixture of samples and the above date is the average of two tests: sample Y-142-4 was dated at 5490 ± 85 BP, and another portion of the same piece of wood, Y-142-3', was dated at 5660 ± 90 (3). See also the Early Stone Age list no. 15, and Iron Age list no. 52-54. Bond (28) has investigated the geological deposits.

30. Y-142-7. Zenebi, Nigeria $\frac{5440 \pm 110}{3490 \text{ BC}}$

Wood from a large log imbedded in the older tin-bearing alluvium in Zenebi No. 1 Paddock on the Zenebi River, near Jos. Associated with a Middle Stone Age industry, it supports the date of no. 29 above. Collected in 1948 by B. Fagg and G. Bond (3).

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III. LATER STONE AGE

a. SOUTH AFRICA

Lab. No.	Date	$\frac{B.P.}{B.C.}$	Site	Associations	Sample	Reference
1. L-336H	$11,250 \pm 400$		Matjes River,	Layer D.	? Charcoal	16
	9300 BC		Cape	Smithfield A		
1a L-336G	$10,500 \pm 400$		"	"	"	"
	8550 BC					
2. L-336E	7750 ± 300		"	Layer C.	"	"
	5800 BC			Wilton		
3. L-336F	5400 ± 250		"	"	"	"
	3450 BC					
4. SR-34	5200 ± 140		Windhoek, South	Quartz industry	Elephant	10
	3250 BC		West Africa		tusk	
* 5. C-911	3368 ± 200		Philip Cave,	Smithfield/	Charcoal	3
	1418 BC		South West	Wilton		
			Africa			
6. R-23	280 ± 80		"	Surface of cave	"	14
	AD 1670			deposit		
7. BM-31	1020 ± 150		Magabengberg,	Later	"	5
	AD 930		Transvaal	Smithfield		
8. BM-42	870 ± 150		Olieboompoort,	"	Charred	"
	AD 1080		Transvaal		bone	

b. CENTRAL AFRICA

9. UCLA-629	$12,200 \pm 250$		Tshangula Cave,	Lower Wilton:	Charcoal	15
	10,250 BC		Rhodesia	Scraper industry		
10. UCLA-172	$12,970 \pm 250$		Calunda 3,	Lower	"	8
	11,020 BC		Angola	Tshitolian		
?11. Y-808 c.r.	$10,820 \pm 340$		Kasama Cave,	Nachikufan II	"	6
	8870 BC		Zambia			
a.s.f.	$11,700 \pm 280$					
	9750 BC					
?12. Y-620B	9720 ± 550		Nachikufu Cave,	"	"	"
	7770 BC		Zambia			
?13. Y-625	8640 ± 240		Kasama Cave,	"	"	"
	6690 BC		Zambia			
?14. Y-805 c.r.	7320 ± 200		Kasama Cave,	Nachikufan II	Charcoal	6
	5370 BC		Zambia	or III		
a.s.f.	7200 ± 200					
	5250 BC					
?15. Y-623 c.r.	3460 ± 200		Nachikufu Cave,	Nachikufan I	"	"
-624	1510 BC		Zambia			
a.s.f.	7540 ± 600					
	5590 BC					
?16. Y-791	5630 ± 200		"	Nachikufan II	"	"
	3680 BC					
?17. Y-619	5000 ± 200		"	Nachikufan III	"	"
	3050 BC					

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b. CENTRAL AFRICA (cont.)

Lab. No.	Date	B. P. B. C.	Site	Associations	Sample	Reference
Y-619 bis	4830 ± 320		Nachikufu Cave,	Nachikufan III	Charcoal	6
	2880 BC		Zambia			
718. Y-799	1060 ± 100		"	Nachikufan II	"	"
	AD 890					
19. SR-12	9400 ± 100		Pomongwe Cave,	Scraper industry in	"	10
	7450 BC		Rhodesia	white ash layer		
720. SR-13	7690 ± 140		"	"	White ash	"
	5740 BC					
21. SR-14	7610 ± 110		"	Wilton	Ash	"
	5660 BC					
722. W-283	$21,000 \pm 500$		Ishango,	Crude quartz industry	Shell	1
	19,050 BC		Congo	with bone harpoons		
W-284	3000 ± 200					
	1050 BC		"	Modern shell	"	"
23. UCLA-167	6830 ± 120		Mufo Mine	Early Tshitolian	Wood	8
	4880 BC		Angola			
24. UCLA-171	4700 ± 100		Calunda 3 Mine	Late Tshitolian	"	"
	2750 BC		Angola			
25. UCLA-170	1800 ± 80		Furi I Mine	"	"	"
	AD 150		Angola			
*26. C-663	6310 ± 250		Chifubwa	Nachikufan I	Charcoal	2
	4360 BC		Stream, Zambia			
27. Lv-45	6030 ± 190		Mt. Gafula,	Late Tshitolian	"	7
	4080 BC		Congo			
28. UCLA-174	4700 ± 100		Lochinvar	Wilton	Wood	8
	2750 BC		Mound, Zambia			
29. UCLA-173	4300 ± 100		"	"	Charcoal	8
	2350 BC					
30. M-1324	4650 ± 150		"	"	"	12
	2700 BC					
31. M-1323	4450 ± 150		"	"	"	"
	2500 BC					
32. Not published	4785 ± 70		Lochinvar, Gwisho	"	Not published	17
	2835 BC		'B' site, Zambia			
33. "	3680 ± 70		"	"	"	"
	1730 BC					
34. "	3660 ± 70		"	"	"	"
	1710 BC					
35. BM-57	4200 ± 150		Amadzimba	Lower Wilton	Carbonized	4
	2250 BC		cave Rhodesia		bone & wood ash	
*36. C-830	2139 ± 150		Lusu Village,	Late Wilton	Charcoal	3
	189 BC		Zambia			
37. SR-15	1220 ± 100		Dombozanga	Wilton	"	10
	AD 730		cave Rhodesia			

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c. EAST AFRICA

Lab No.	Date $\frac{\text{B. P.}}{\text{B. C.}}$	Site	Associations	Sample	Reference
?38. NPL-37	$\frac{18,190 \pm 306}{16,240 \text{ BC}}$	Kisese rock shelter, Tanzania	Second Intermediate/ Later Stone Age transition	Charred Ostrich eggshell	13
?39. NPL-35	$\frac{14,760 \pm 202}{12,810 \text{ BC}}$	"	Middle part of Later Stone Age	"	"
?40. NPL-36	$\frac{10,720 \pm 132}{8770 \text{ BC}}$	"	Early Later Stone Age	"	"
41. Y-91	$\frac{2920 \pm 80}{970 \text{ BC}}$	Njoro River cave, Kenya	Elmenteitan with stone bowls	Charcoal	9

ADDITIONAL NOTES ON LATER STONE AGE SITES

Matjes River series, South Africa

The Matjes River rock shelter is situated at the mouth of the Matjes River (34° 01' S, 23° 25' E) near Plettenberg Bay in the south Cape coastal region. Originally excavated by Dreyer in 1929 (20), the deposit was re-excavated between 1952 and 1958 by Dr. A.C. Hoffman, Dr. A.J.D. Meiring and Dr. J.T. Louw of the National Museum, Bloemfontein. The deposit is composed mainly of some 34 ft. of shell midden debris in which several Later Stone Age horizons have been distinguished, together with human skeletal material and faunal remains. Louw (16) has recognised the following succession:

- Layer E (at the base): An indeterminable quartzite flake industry associated with rolled pebbles and ash.
- Layer D: Smithfield A cultural material with re-used Middle Stone Age points, associated with extant species of antelope, *Donax* shells and human skeletal remains.
- Layer C: Wilton cultural material without pottery, associated with the same faunal material as above, and with human skeletal remains closely resembling those from Oakhurst (19); one burial was covered with a painted burial stone (18).
- Layer B: Smithfield B cultural material, associated with blue mussel shells, fewer antelope than were present in Layers C and D and 'Proto-Bushman' remains.
- Layer A: Smithfield B cultural material (Strandlooper variant of Louw), associated with remains of small antelope and *Donax* shells.

The dates are internally consistent although somewhat older than would be expected by comparison with other Later Stone Age dates from South Africa and other dates from similar shelters are needed to confirm their age. It is also interesting to note that the cultural succession here is different from the nearby Oakhurst shelter (Cronin, 22) where the Smithfield B was overlain by Smithfield C and the Wilton levels were at the top of the deposit.

See also Clark (21) for further comments.

- | | | |
|----|----------------------------|-----------------------------|
| 1. | L-336H. Matjes River, Cape | $11,250 \pm 400$
9300 BC |
|----|----------------------------|-----------------------------|

Presumably charcoal (details of material submitted not published) from Layer D, Smithfield A cultural level (16).

- | | | |
|-----|----------------------------|-----------------------------|
| 1a. | L-336G. Matjes River, Cape | $10,500 \pm 400$
8550 BC |
|-----|----------------------------|-----------------------------|

?Charcoal from Layer D, Smithfield A cultural level (16).

- | | | |
|----|----------------------------|---------------------------|
| 2. | L-336E. Matjes River, Cape | 7750 ± 300
5800 BC |
|----|----------------------------|---------------------------|

?Charcoal from Layer C, Wilton cultural level (16).

3. **L-336F. Matjes River, Cape** 5400 ± 250
3450 BC

Sample from Layer C; Wilton cultural material (16).

4. **SR-34. Zoo Park Gardens, Kaiserstrasse, Windhoek** 5200 ± 140
3250 BC

A large piece of elephant tusk from the Zoo Park Gardens (22° 55'S; 17° 05'E). The remains of an elephant were associated with a quartz stone industry, analysis of which may prove important in relating the stone industry to a specific industrial activity. Collected by R. MacCalman, State Museum Windhoek. (10).

5. **C-911. Philip Cave, South West Africa** 3368 ± 200
1418 BC

Charcoal from Philip Cave (Ameib) south east of the Erongo mountains in South West Africa (ca. 22° 00'S, 16° 20'E), found stratified in the deposit in direct association with ochre for making the paintings which cover the cave walls (3). The date has been accepted by H. Breuil (23) as an indication of the age of the principal cycle of paintings in the cave. Clark (21) states that the sample came from the middle levels of the cave deposit and is associated with a Smithfield/Wilton industry.

6. **R-23. Philip Cave, South West Africa** 280 ± 80
AD 1670

Charcoal fragments 2 to 3 cm in diameter found on the surface of the deposit in the same cave as above; submitted in 1952 by the late H. Breuil. **Comment** (14): owing probably to a spring that in the past had deposited calcareous tufa, this charcoal was so strongly lithified by CaCO_3 that the fragments had to be reduced to a fine powder before the carbonate could be wholly eliminated by repeated treatment with 10% HCL. The age shows that the sample is fairly recent and thus sample C-911 was believed by the Abbe Breuil to date the paintings (14).

7. **BM-31. Magabengberg, Transvaal** 1020 ± 150
AD 930

Charcoal from Bed 1 in Magabengberg Cave (23° 15'S; 28° 55'E), Northern Transvaal, and found in association with a Later Smithfield industry. Excavated in 1954 by Jean Humphries (5), and discussed in detail by Mason (24).

8. **BM-42. Olieboompoort Cave, Transvaal** 870 ± 150
AD 1080

Charred bone from Bed 3, Olieboompoort cave (23° 50'S; 27° 40'E) in the Waterberg, western Transvaal, and found in association with a Later Smithfield industry. Excavated in 1954 by R.J. Mason (5). Mason (24) has made statistical comparisons between this industry and that from Magabengberg.

9. **UCLA-629. Tshangula cave, Rhodesia** 12,200 ± 250
10,250 BC

Charcoal from the bottom of the Wilton layer in Tshangula cave, Rhodesia

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(20° 25'S; 28° 35'E), and overlying a white ash layer with an unusual scraper industry (25). Excavated in 1963 as a check against the earlier excavation of Pomongwe cave by C.K. Cooke (15). **Comment** (15): the result is older than expected in view of the date of 9400 ± 100 (this list, No. 21) for the same cultural level at Pomongwe. It could be consistent, however, if the sample came from the consolidated white ash floor and was covered by ash of the later occupation. For further dates from Pomongwe, see the Middle Stone Age list Nos. 19-22, and this list Nos. 19-21.

10. UCLA-172. Calunda 3 mine, Angola

$12,970 \pm 250$

11,020 BC

Charcoal from the lower part of the Redistributed Sands over the lower stream gravel (8), and dating the Lower-Tshitoli culture, (25). For other dates from the same series, see the Middle Stone Age list Nos. 15-18, and this list Nos. 23, 26, 27.

Kasama and Nachikufu series, Zambia

Charcoal from various cultural levels at Nachikufu cave (12° 14'S; 31° 15'E) near Mpika in Zambia, the type site of the Nachikufu Later Stone Age culture, and at the related rock-shelter site of Kasama (10° 13'S; 31° 12'E). Excavations at Nachikufu in 1953 by J. Desmond Clark, and at Nachikufu and Kasama in 1955 by Mrs. L. Hodges (6). **Comment** (6): Except for Y-791, all samples were pre-treated with alkali as usual. Samples believed to be bone charcoal (Y-805, Y-808, Y-623-624) were divided during pretreatment, and the alkali-soluble material was dated separately. Normally, as found by the Groningen Laboratory, the alkali-soluble fraction is at least slightly older, and, as the removal of soluble material is not 100% complete, doubt is thrown on both measurements. This series of dates, though reasonably consistent internally, is in serious conflict with archaeological evidence at several points. Nachikufan III contains pottery, and iron slag was found down to 1.5 ft. depth, immediately overlying Y-619: its 5,000 year date is considered impossibly old. Nachikufan II contains polished stone axes, not known to be older than 6300 years even in North Africa, whence the Neolithic presumably came, and while Y-791 is reasonable, it is the least reliable on technical grounds, and the older dates (Y-620B, Y-625, Y-808) are much too old. Nachikufan I was dated at the Chifubwa rock shelter at 6310 BP (this list No. 24), but if the alkali-soluble fraction of Y-623-624 is arbitrarily selected as consistent with this date, all dates for Nachikufan II and III must be rejected. As the gross error of Y-624-624 shows, there is clearly something wrong about bone charcoal, but bone was not a major constituent of most of the samples, and the direct tests do not suggest that error from this source is quantitatively sufficient to account for the discrepancies. Apart from archaeological difficulties, which can only be resolved by new excavations, sources of error are probably geochemical (absorption of humic material after burial) and biologic (fractionation of carbon isotopes by food plants, by animals, and by the charring process) (6). See report by Clark (26) on earlier excavations at Nachikufu.

11. **Y-808. Kasama cave, Zambia** 10,820 ± 340
charcoal residue 8870 BP
11,700 ± 280
alkali soluble fraction 9750 BC
From 4.5 to 7.0 ft. depth, Nachikufan II. (6)
12. **Y-620B. Nachikufu cave, Zambia** 9720 ± 550
7770 BC
From 1953 excavation, 3.0 to 3.5 ft. depth. **Comment:** a mislabelled sample (Y-620), supposedly from this layer, gave 400 ± 130 BP and has been rejected (6). Nachikufan II cultural level.
13. **Y-625. Kasama cave, Zambia** 8640 ± 240
6690 BC
From 3.0 to 3.5 ft. depth. Nachikufan II. (6)
14. **Y-805. Kasama cave, Zambia** 7320 ± 200
charcoal residue 5370 BC
7200 ± 200
alkali soluble fraction 5250 BC
From 2.5 to 3.0 ft. depth. Nachikufan III or II. (6)
15. **Y-623-624. Nachikufu cave, Zambia** 3460 ± 200
charcoal residue 1510 BC
7540 ± 600
alkali soluble fraction 5590 BC
Combined samples from 1953 excavation, from 6.0 to 7.0 and 7.0 to 8.0 ft. depth. Nachikufan I cultural level. (6)
16. **Y-791. Nachikufu cave, Zambia** 5630 ± 200
3680 BC
From 2.5 to 3.0 ft. depth, 1953 excavation, dating the Nachikufan II cultural level. **Comment:** Sample very small and not pretreated with alkali (6).
17. **Y-619. Nachikufu cave, Zambia** 5000 ± 200
3050 BC
From 1.5 to 2.0 ft. depth, 1953 excavation, dating the Nachikufan III cultural level. As mentioned above, this date is far too early. (6)
- Y-619 bis. Nachikufu cave, Zambia** 4830 ± 320
2880 BC
Re-check of Y-619 with new preparation. Also dates Nachikufan III, but it is far too early due to some sort of contamination. (6)
18. **Y-799. Nachikufu cave, Zambia** 1060 ± 100
AD 890
From 5.0 to 7.0 ft. depth, 1955 excavation, dating the Nachikufan II cultural level. **Comment:** This sample presumably represents contaminating Iron Age material from overlying levels and is therefore rejected (6).
Pomongwe series, Rhodesia
Pomongwe cave in the Matopo Hills (20° 32'S; 28° 30'E) has yielded a

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long cultural succession from Sangoan or Proto-Stillbay at the base, through Stillbay, Magosian and an unusual scraper industry in a white ash layer to Wilton and Iron Age. Excavated 1960/61 by C.K. Cooke (10, 11). For earlier dates, see Middle Stone Age list Nos. 19-22, and Earlier Stone Age list Nos. 13, 14.

19. SR-12. Pomongwe, Rhodesia

9400 ± 100

7450 BC

Small twig charcoal associated with the white ash layer and an unusual scraper industry between the Magosian and Wilton levels; very early Wilton (10, 11). From 2 ft. 3 in. depth, Layer 3 I-K 8-10. The sample was combusted twice and counted four times as the age did not agree with that of the white ash from the same layer (11), and Cooke (11) has accepted a suggestion by Swart (11) that the charcoal date (SR-12) be accepted as the more correct for this cultural level. Cooke comments further that the collection of this charcoal was difficult as the whole deposit was so completely burnt. The charcoal was hand-picked from the deposit piece by piece because it was so fragmentary. There is no possibility of any contamination with the level immediately below, which has been dated to 15,800 BP.

20. SR-13. Pomongwe, Rhodesia

7690 ± 140

5740 BC

White ash sample, consisting largely of inorganic carbonates, from the same layer as above. It appears to be younger than SR-12 probably as a result of exchange with atmospheric CO₂ (10). The older date (SR-12) is considered by the laboratory and by Cooke (11) to be more accurate.

21. SR-14. Pomongwe, Rhodesia

7610 ± 110

5660 BC

The sample was collected from a deposit of ash consisting of a burnt nut from the *Scelerocayre caffra* (Marula) tree. From layer 2 E-G 6-8 and associated with the lower levels of the Wilton. This date is much earlier than others from Wilton levels in the same region. Cooke (11) notes that the sample was taken from the midden immediately above the white ash layer which may account for its unexpected age. A similar reason has been given for the even earlier date of 12,200 BP (No. 9, this list) for the Wilton from Tshangula cave. A lot more dates from similar cultural levels are needed before this problem can be resolved.

Ishango series, Congo

Ishango, on the north western shore of Lake Edward, Congo, was excavated in 1950 by J. de Heinzelin. The occupation horizon, overlain by volcanic tuffs, can be divided into three distinct layers of sediment and contain a unique cultural assemblage with a crude quartz industry, highly developed bone harpoons showing a progressive technical development, bone points, pestles and grind-stones, associated with human remains (possibly Negroid), mammal and fish bones (1, 26, 27), but no pottery.

After dating the modern shells (W-284), it was realised that Lake Edward was receiving an addition of C12 from mineral springs and volcanic eruptions,

upsetting the normal balance of carbon isotopes and making the dates abnormally old. By extrapolation, de Heinzelin believes the deposit to date between 6500 and 9000 BC (27), while the laboratory (1) concludes that sample W-283 has a maximum age of 18,000 years.

22. **W-283. Ishango, Congo** 21,000 ± 500
19,050 BC

Shells from the culture horizon

- W-284. Ishango, Congo** 3000 ± 200
1050 BC

Modern shell collected from the present beach.

23. **UCLA-167. Mufo Mine, Angola** 6830 ± 120
4880 BC

Wood from the Upper Sand Bed in the Flats Terrace at a depth of 5 ft. and dating the early Tshitoliian cultural phase (8), from waterlaid sands overlying the Upper Gravels of the 3-4m terrace in the centre of the Luembe River valley (25). For general description of the area, see Middle Stone Age list Nos. 15-18.

24. **UCLA-171. Calunda 3 Mine, Angola** 4700 ± 100
2750 BC

Peat and wood from the Lower Stream Gravels exposed just below water level, dating the Tshitoliian (25) or the Late Tshitoliian (8). See also Middle Stone Age list Nos. 15-18.

25. **UCLA-170. Furi I Mine, Angola** 1800 ± 80
AD 150

Wood from the resorted gravels of the present channel of the Luembe river. Late Tshitoliian culture with tools and potsherds indicating resorting in Iron Age times (8), or Early Iron Age (25). **Note:** this date has also been quoted as 1880 ± 80 BP: the date published by the laboratory is taken as the correct one. See also Middle Stone Age list Nos. 15-18.

26. **C-663. Chifubwa Stream rock shelter, Zambia** 6310 ± 250
4360 BC

Charcoal from the Chifubwa stream shelter about 4 miles from Solwezi in the Kafue basin. The walls of the shelter show rock engravings of a stylized and schematic nature which have been covered in part by the accumulated cave deposit (29). The sample is from the lowest 18 ins. of an orange sand and the top 4-6 ins. of a Late Stone Age Nachikufan I industry (2).

Clark (29) notes that the charcoals were small fragments scattered throughout the deposit and did not come from a recognizable hearth. It is therefore possible that they may have been old or 'fossil' charcoals washed into the deposit from the top of the gorge. It will therefore be necessary to obtain other confirmatory evidence from other sites before assigning the engravings to this date.

27. **Lv-45. Mt. Gafula, Congo** 6030 ± 190
4080 BC

Charcoal from Mt. Gafula (4° 28'S; 15° 13'E), Province of Leopoldville,

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in sand at a depth of 2m. The sample is from a factory floor characteristic of the Late Tshitolian (7).

Lochinvar series, Zambia

Lochinvar Ranch, some 27 miles north-west of Monze, Zambia, where Wilton cultural material has been excavated around a hot spring mound to a depth of over 8 ft. Excavated in 1960 by Creighton Gabel and in 1963 by B.M. Fagan. The cultural material was associated with burials, faunal remains, shell beads and vegetable material such as nuts, seeds and reed fragments. Artefacts of wood have also been recovered. Remains of some 16 individuals were found in 1960, and a further 10 in 1963 and Gabel (31) states that they have more affiliations with Bush than with Negro skulls. (30, 32, 8). **Comment:** UCLA-173 and UCLA-174 were the first samples run and the results are not in stratigraphic order. Further samples M-1324 and M-1323 were therefore submitted from the 8 ft. depth. Dates numbered 32, 33 and 34 below have not yet been published from the laboratory and details are therefore not known.

28. **UCLA-174. Lochinvar, Zambia** 4700 ± 100
2750 BC

Wood from a depth of 5 ft. associated with a human skeleton. Collected in 1960 excavations by C. Gabel (8).

29. **UCLA-173. Lochinvar, Zambia** 4300 ± 100
2350 BC

Charcoal from a depth of 8 ft. in association with fossil fauna, Wilton implements and a wooden digging stick. Collected during 1960 by C. Gabel (8).

30. **M-1324. Lochinvar, Zambia** 4650 ± 150
2700 BC

Charcoal from grid square 6L24, 96 in. depth, collected in 1961 by C. Gabel (12).

31. **M-1323. Lochinvar, Zambia** 4450 ± 150
2500 BC

Charcoal from grid square 6L17, 96 in. depth, collected 1961 by C. Gabel. Gabel (12) comments that the UCLA dates are therefore probably essentially correct. (30, 31, 33).

32. ? **Lochinvar, Zambia** 4785 ± 70
2835 BC

From Gwisho 'B', excavated in 1963 by B.M. Fagan. Details not known (17).

33. ? **Lochinvar, Zambia** 3680 ± 70
1730 BC

From Gwisho 'B' site, excavated in 1963 by B.M. Fagan (17, 32).

34. ? **Lochinvar, Zambia** 3660 ± 70
1710 BC

From Gwisho 'B' site, excavated in 1963 by B.M. Fagan (17, 32).

35. **BM-57. Amadzimba cave, Rhodesia** 4200 ± 150
2250 BC

Carbonized bone and wood ash from the lower half of the Wilton horizon at a depth of 6 to 12 ins., squares Ce and Cf, at Amadzimba cave (20° 45'S; 28° 45'E), in the south Matopos. Collected in 1954 by K.R. Robinson. The Wilton industry at this site shows the additional unusual element of a large number of polished bone tools (34, 4).

36. **C-830. Lusu Village, Zambia** 2139 ± 150
189 BC

Charcoal collected in what appeared to be a large hearth in Lusu Village, on the Zambezi river in the Shesheke district of Zambia. The sample was taken by J.D. Clark just above the spot where shards of Stamped Ware pottery of a believed Rhodesian Wilton occupation were found. This is overlain by 2 ft. 7 in. of re-deposited Kalahari sands. The charcoal layer averages just over 1 in. thick and extends for 8 ft. along the face of the section. (3)

The date is the average of two samples: 2025 ± 230 BP and 2353 ± 180 BP. (3)

37. **SR-15. Dombozanga, Rhodesia** 1220 ± 100
AD 730

Dombozanga rock shelter in Rhodesia between Beit Bridge and Bulawayo. Charcoal was collected throughout the Wilton deposit from 8 to 10 ins. below the surface. Above the 8 in. level, Wilton was mixed with Iron Age potsherds. (10, 37) **Kisese rock shelter series, Tanzania**

Kisese II rock shelter in the Kondoa district (4° 25'S; 35° 50'E) of Tanzania, was excavated in 1956 by R.R. Inskeep to a depth of 20 ft. below the modern ground surface. An unbroken succession of stone industries was recognized, ranging from Second Intermediate, through Wilton to evidence of Iron Age activity in the topmost levels. The shelter has some rock paintings on the walls and exfoliated slabs of rock were found in the deposit and may help to date the paintings (35, 13).

The material dated was charred ostrich eggshell; however the dates seem far too old and are not in strict stratigraphic order so that in view of the careful pretreatment given to the samples, the suitability of ostrich eggshell requires investigation (13).

38. **NPL-37. Kisese rock shelter, Tanzania** 18,190 ± 306
16,240 BC

Sample from the transition stage between the Second Intermediate and the Later Stone Age. (13)

39. **NPL-35. Kisese rock shelter, Tanzania** 14,760 ± 202
12,810 BC

Sample from the middle part of the Later Stone Age sequence. (13)

40. **NPL-36. Kisese rock shelter, Tanzania** 10,720 ± 132
8770 BC

Sample from the early part of the Later Stone Age sequence. (13)

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41. Y-91. Njoro River cave, Kenya

2920 ± 80
970 BC

Njoro River cave on the banks of the Njoro river (approx. $0^{\circ} 20'S$; $35^{\circ} 58'E$) in Kenya was excavated in 1938 by Dr. and Mrs. L. S. B. Leakey. In a series of parallel trenches, cremated burials of about eighty individuals were found associated with obsidian implements of Elmenteitan facies, potsherds, stone bowls, pestles, lower grindstones, considerable quantities of stone beads, a single carved wooden vessel, basket-work, gourds, but no trace of metal (36). Charcoal was collected from several graves for dating (9).

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IV. IRON AGE

a. SOUTH AFRICA

Lab. No.	Date	B. P. B. C.	Site	Associations	Sample	Reference
1. Y-135-17	900 ± 65 AD 1050		Bambandyanalo, Transvaal	Iron Age burial	Charred millet	8
2. Y-1338	890 ± 50 AD 1060		Melville Koppies, Transvaal	Iron Age I	Charcoal	20
3. Y-135-14	570 ± 60 AD 1380		Mapungubwe, Transvaal	Iron Age settlement	Charcoal	8
4. Y-135-9	530 ± 60 AD 1420		"	"	Charred millet	"
5. Y-1323B	300 ± 80 AD 1650		Uitkomst Cave, Transvaal	Iron Age	Charcoal	20
? BM-	9844 ± 200 7894 BC		"	Probably Later Stone Age contamination	"	27

b. CENTRAL AFRICA

?* 6. C-662	4078 ± 300 2128 BC		Situmpa, Zambia	Early Bantu penetration ?	Charcoal	2
* 7. C-829	1854 ± 220 AD 96		"	Check sample against C-662	"	5
8. SR-17	1650 ± 100 AD 300		Ziwa Farm, Rhodesia	Iron Age grave	"	15
9. SR-32	1100 ± 100 AD 850		"	Iron Age ritual pit	"	"
10. SR-38	1050 ± 100 AD 900		"	Iron Age grave	"	"
11. SR-26	1420 ± 120 AD 530		Gokomere, Rhodesia	Iron Age: Stamped Ware	Wood charcoal	"
?*12. C-917	1506 ± 305 AD 444		Zimbabwe, Rhodesia	Drain lintel from 'Temple'	Wood	5
?*13. C-613	1361 ± 120 AD 589		"	"	"	2
? 14. GL-19	1240 ± 80 AD 710		"	"	"	26
15. M-913	1630 ± 150 AD 320		"	End of Period I	Charcoal	3
16. M-914	875 ± 150 AD 1075		Zimbabwe, Rhodesia	Period III on 'Acropolis'	"	3
17. M-915	510 ± 150 AD 1440		"	Period IV on 'Acropolis'	"	"
18. B-263	1240 ± 120 AD 710		Sanga, Congo	Kisalian Culture	Bone	6
19. B-264	1070 ± 200 AD 880		"	"	"	"
20. L-395B	1080 ± 180 AD 870		Kalambo Falls, Zambia	Early Iron Age 'Channelled Ware'	Charcoal	7

DEACON - RADIO CARBON DATES

b. CENTRAL AFRICA (cont.)

Lab. No.	Date B. P. B. C.	Site	Associations	Sample	Reference
21. SR-33	<u>1110 ± 100</u> AD 840	Malapati, Rhodesia	Iron Age midden: Stamped pottery	Charcoal	15
22. Y-587	<u>1240 ± 100</u> AD 710	Feti la Choya, Angola	Fortified Iron Age site	"	14
23. Y-588	<u>700 ± 65</u> AD 1250	"	"	"	"
24. SR-19	<u>1300 ± 90</u> AD 650	Isamu Pate, Zambia	Iron Age mound, Kalomo Culture	"	21
25. R-874(NZ)	<u>995 ± 61</u> AD 955	"	"	"	"
26. UCLA-177	<u>960 ± 70</u> AD 990	"	"	"	13
27. SR-30	<u>930 ± 100</u> AD 1020	"	"	"	21
28. UCLA-176	<u>890 ± 70</u> AD 1060	"	"	"	13
29. UCLA-175	<u>710 ± 50</u> AD 1240	"	"	"	"
30. SR-31	<u>900 ± 90</u> AD 1050	"	"	"	21
31. SR-20	<u>910 ± 100</u> AD 1040	"	"	"	"
32. SR-23	<u>1150 ± 100</u> AD 800	Ingombe Ilede, Zambia	Iron Age village	"	"
33. SR-22	<u>1120 ± 200</u> AD 830	"	"	"	"
34. Q-720	<u>965 ± 100</u> AD 985	"	"	"	19
35. R-908(NZ)	<u>486 ± 87</u> AD 1464	"	"	"	42
36. GrN-3580	<u>930 ± 40</u> AD 1020	Kalambo Falls, Zambia	Iron Age	?Charcoal	21
37. GX-0109	<u>750 ± 135</u> AD 1200	Sebanzi Hill, Zambia	Iron Age: Tonga pottery	Charcoal	"
38. SR-28	<u>800 ± 100</u> AD 1150	Kamusongolo cave, Zambia	Iron Age: comb- stamped pottery	"	15
39. SR-37	<u>800 ± 90</u> AD 1150	Mutema's Sacred Grove, Rhodesia	Iron Age	Wood	15
40. SR-36	<u>720 ± 120</u> AD 1230	"	"	"	"
41. Y-722	<u>670 ± 100</u> AD 1280	Graniteside, Rhodesia	Iron Age burial site	Charcoal	10
42. GrN-2341	<u>680 ± 60</u> AD 1270	"	"	"	18
43. SR-25	<u>650 ± 120</u> AD 1300	Harleigh Farm, Rhodesia	Iron Age: Zimbabwe Culture	"	15
44. GrN-3189	<u>370 ± 50</u> AD 1580	Kalambo Falls, Zambia	Iron Age	?Charcoal	21

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b. CENTRAL AFRICA (cont.)

Lab. No.	Date $\frac{\text{B.P.}}{\text{B.C.}}$	Site	Associations	Sample	Reference
45. Y-618	300 ± 200 AD 1650	Nachikufu Cave, Zambia	Iron Age	Charcoal	11
46. Y-796	200 ± 100 AD 1750	"	"	"	"
47. SR-35	280 ± 90 AD 1670	Harleigh Farm, Rhodesia	Iron Age	"	13

c. EAST AFRICA

48. M-1113	925 ± 150 AD 1025	Nsongezi, Uganda	Iron Age: Dimple- based pottery	"	12
49. M-1114	125 ± 150 AD 1825	"	Sample contaminated	"	"
50. Y-570	375 ± 100 AD 1575	Lanet, Kenya	Lanet earthworks	"	10
51. BM-52	100 ± 150 AD 1850	Gaan Nibaah, Somaliland	Recent grave	Wood	9

d. WEST AFRICA

52. Y-475	4060 ± 140 2110 BC	Nok, Nigeria	Nok figurines	"	1
53. Y-142-4	2875 ± 70 925 BC	"	"	"	"
54. Y-474	1750 ± 80 AD 200	"	"	"	"

e. OTHER

55. GaK-276	840 ± 80 AD 1110	Talaky, Madagascar	Settlement with iron	Charcoal	4
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ADDITIONAL NOTES ON IRON AGE DATES

Bambandyanalo and Mapungubwe series

Mapungubwe Hill and the nearby site of Bambandyanalo (K. 2) (22° 05' S; 29° 20' E) are on the farm Greefswald in the Northern Transvaal. K. 2 and the 'great depression' on the Mapungubwe Hill summit were excavated in 1935-40 by Capt. G. A. Gardner whose account and conclusions have been recently published (24). The skeletal remains are considered to be Khoisan from Bambandyanalo, but the later inhabitants show mixing with the Bantu (22). While Gardner considers that the Hottentot occupants in the lower levels are not Iron Age *per se*, Fagan (23) considers that the whole sequence must be considered as Iron Age and compares the pottery styles with those from Rhodesia.

The cultural sequence as recognized by Gardner from K. 2 (Bambandyanalo) and from the Hill (Mapungubwe) is as follows:

Lowest levels: Stone Age Magosian material on the summit of the Hill. Not dated. Depth: 10-11 ft. below surface.

K. 2, 1st Phase: Proto-Hottentot cultural and skeletal evidence. No traces of permanent huts or stone walling. Abundant well-made pottery of Schofield's M. 2 class (58), evidence for the domestication of cattle (Afrikander and Sanga types) and highly probable evidence for sheep as well. No evidence for iron smelting, but 16 of the 72 burials had iron or copper bracelets and anklets and a single copper finger ring was recovered. Very few finds of metal weapons. Dated to AD. 1050 (Y-135-17).

K. 2, 2nd Phase: Proto-Hottentots and so-called Nguni Bantu invaders mix; mixed pottery and isolated find of iron hoe. Destruction of K. 2.

Hill, 3rd Phase: The lower levels of the great depression on Mapungubwe Hill yielded 11 ft. of deposit. Overlying the Stone Age Magosian horizon is some 2 ft. of accumulated deposit, which Gardner attributes to a hybrid Hottentot/Bantu population. The pottery shows a survival of the Phase 1 tradition, cane and garden roller beads are present. Iron assegais and spears were also recovered. An interesting hut complex with a carved wooden door is the earliest such dwelling from the site.

Gardner's Zone 2; Depth 7-9 ft. from surface.

Suggested date: AD 1250-1300

Hill, 4th Phase: People with Sotho pottery tradition occupied site and a thick layer of black ash separates 3rd and 4th phases. Pottery classed as Schofield's M. 1 (58). Finding of a spindle-whorl suggests weaving of bark cloth: iron hoes and evidence for metal working found. Charred millet attests to agriculture.

Gardner's Zone 3; Depth 5-7 ft. Dated to A.D. 1380 (Y-135-14).

Hill, 5th Phase: People of Venda stock apparently occupied the Hill: another thick layer of ash separated phases 5 and 4. New types of beads and

pottery introduced. Evidence for stone walling and iron smelting, as well as for cattle and agriculture.

Gardner's Zone 4; Approximately 4 ft. depth from surface. Dated to A.D. 1420 (Y-135-9).

Hill, 6th Phase: Remains attributed to Hottentot settlement of the Hill summit: remarkable numbers of bone arrows found, also gold with burials on the Hill which Gardner attributes to contact with the Venda. No indication of cultivation of grain, but there is evidence for cattle and sheep. Historical tradition suggests that these may have been migrant Korana Hottentots. Gardner's Zone 5: Depth 2-3 ft. from the surface. Suggested date about A.D. 1750-1800.

Hill, 7th Phase: A complete desertion of the Hill.

See also original excavation report by Fouché (25).

1. **Y-135-17. Bambandyanalo, Transvaal** 900 ± 65
AD 1050

Charcoal accompanying ceremonial beast-burial No. 6, with 14 pots from Site K. 2, depth 5.5 ft; blocks 4-6, strip 6, co-ordinates A-14', R-7 (8).

3. **Y-135-14. Mapungubwe, Transvaal** 570 ± 60
AD 1380

Charred millet and wood from a burned hut found at position 35' 0' 5' (5 ft. depth) in block 6, strip 4. (8).

4. **Y-135-9. Mapungubwe, Transvaal** 530 ± 60
AD 1420

Charred millet from position 6' 58' 3' (3 ft. depth) in block 2, strip 4 (8).

2. **Y-1338. Melville Koppies, Transvaal** 890 ± 50
AD 1060

Melville Koppies, situated in suburban Johannesburg, is a Nature Reserve where surface finds of pottery led to excavations by Dr. R. J. Mason in 1963. An Iron Age furnace was recovered and this dated sample consisted of charcoal nodules taken from the inside of the furnace at a level of 11" to 12" below datum, the level of the living floor from which the furnace was worked. There is every indication that the charcoal was burnt in the operation of the furnace itself and there is no evidence of contamination from earlier levels. The furnace is probably associated with a nearby stone-walled settlement and with comb-stamped pottery (20).

5. **Y-1323B. Uitkomst Cave, Transvaal** 300 ± 80
AD 1650
9844 ± 200
7894 BC

BM-

Sample Y-1323 B was from the surface of the uppermost furnace in Bed 3 of Uitkomst cave, excavated by R. J. Mason. Evidence of the basic features of an Iron Age community in the form of smelting furnaces, pottery, stone walls and grindstones were found in Beds 2-4 overlying an earlier Later Stone Age deposit.

DEACON - RADIO CARBON DATES

The two smelting furnaces from Bed 2 are considered to be of a more primitive type than those in Bed 3 (27).

The BM- sample which gave an anomalously old date was found, after subsequent excavation, to be part of the Later Stone Age horizon as the builders of the smelting furnace had in part excavated into the earlier deposit (20, Mason pers. comm.)

6. C-662. Situmpa Forest Station, Machili district, $\frac{2078 \pm 300}{2128 \text{ BC}}$
Zambia

Charcoal from pits dug in the Situmpa Forest and taken at the 5 ft. level. Collected by J.D. Clark was originally submitted as it was presumed to tie up with an archaeological locality and it was hoped it would prove a clue as to the age of the Bantu penetration of Barotseland (4). See C-829 below.

7. C-829. Situmpa Forest Station, Zambia $\frac{1854 \pm 226}{\text{AD } 96}$

Charcoal from a depth of 2 ft. 10 ins. in a check pit excavated in 1952 by J.D. Clark. The associated industry includes sherds of Stamped ware (Bambata variant) which is not believed to be as old as indicated by C-662 above. This pit was dug some 5 yds. away from the earlier excavation to check the anomalously early date (5). The pottery is discussed by Inskeep (28) and by Summers (29).

Ziwa Farm series, Inyanga, Rhodesia

Ziwa farm, adjoining the Van Nickerk Ruins at Inyanga which have been described by Summers (31), has been investigated by F.O. Bernhard of Umtali. He has excavated several burials, the skeletal remains being of Negroid type, and has described two distinct types of smelting furnaces (30). These form part of the Ziwa culture. Geographical position: 18° 12' S; 32° 40' E.

8. SR-17. Ziwa Farm, Rhodesia $\frac{1650 \pm 100}{\text{AD } 300}$

Charcoal from a grave site at a depth of 2 ft. 4 ins. Skeleton was that of a young female, about 14 years old (15).

9. SR-32. Ziwa Farm, Rhodesia $\frac{1100 \pm 100}{\text{AD } 850}$

Charcoal from a ritual pit (15).

10. SR-38. Ziwa Farm, Rhodesia $\frac{1050 \pm 100}{\text{AD } 900}$

Charcoal found attached to a skull of a young male, about 16 years old, in a grave excavated on Ziwa Farm (15).

11. SR-26. Gokomere, Rhodesia $\frac{1420 \pm 120}{\text{AD } 530}$

Midden deposit from 60 to 66 ins. depth at the Tunnel Site (19° 55' S; 30° 45' E) at Gokomere near Zimbabwe, Rhodesia. A passage-like rock shelter, the site was originally excavated by Gardner (32), but the material has been lost and subsequent investigations were conducted in about 1962 by K.R. Robinson (16). The cultural assemblage shows close affinities with that from the Chibi

district (34) and with the Class 1 pottery from the Western Enclosure of the Acropolis, Zimbabwe (35).

Zimbabwe series, Rhodesia

Samples from the Zimbabwe ruins complex ($20^{\circ} 15' S$; $30^{\circ} 56' E$) dating the Iron Age sequence. Excavated by various workers (33) and latterly by Summers and Robinson in 1958 (35), the following succession has been recognized in the Western Enclosure on the Acropolis hill:

Period I: At the base of the sequence. Class 1 pottery with stamp and channel decoration.

Period II: Class 2 ware with gourd-shaped pots with rare decoration.

Period III: Class 3 ware; bevelled or rolled rims with rare incised decoration.

Period IV: Class 4 ware; engraved and incised geometrical designs and graphite burnish.

Period V: Class 5 ware with cross-hatched decoration and rough pots.

In 1950 a piece of wood serving as a lintel to a drain was excavated from the Temple or Great Enclosure and was submitted for dating first to Libby (2), C-613, but the date was much earlier than was expected and a second lintel was tested, C-917 (Libby, (5)) and again by Zeuner (26) as GL-19. All the dates gave similar results and it was found that the wood used for the lintels was from the heart of the Tambootie or African Sandalwood (*Spirostachys africana*) tree, a slow-growing hardwood which is never cut for timber as the sap is poisonous. The inference is that the logs may have lain dead for some considerable time before being used as drain lintels. Subsequent dates from charcoal on the Acropolis show that the main period of occupation was considerably later than these original dates suggested. The earlier dates have been discussed in detail by Summers (36, 37).

12. C-917. Zimbabwe, Rhodesia

1506 ± 305
AD 444

Wood from a drain lintel in the Temple or Great Enclosure, this was the second sample submitted and is not considered to date the building of the drain (5, 35, 36, 37).

13. C-613. Zimbabwe, Rhodesia

average of three 1361 ± 120
AD 589

Wood from a drain lintel in the Temple. Three tests were run and gave the following results: 1415 ± 160 , 1344 ± 160 and 1271 ± 260 B.P. After further examination of the wood, the date was not considered to have been contemporary with the building of the drain.

14. GL-19. Zimbabwe, Rhodesia

1240 ± 80
AD 710

Wood from the same log as C-917. See above comment and references; also Zeuner (26).

DEACON - RADIO CARBON DATES

15. **M-913. Zimbabwe, Rhodesia** 1630 ± 150
AD 320

Charcoal from the excavations on the Acropolis. This sample dates the end of the earliest Southern Rhodesian Iron Age, showing that Period II began about the fourth century. There is no date for the beginning of Period I from Zimbabwe, but a somewhat similar ware to Class 1 has been dated from the Zambezi Valley at AD 96 (this list No. 7). Fuller descriptions are given by Robinson (in 35). (3)

16. **M-914. Zimbabwe, Rhodesia** 875 ± 150
AD 1075

Charcoal from the middle level, Period III, on the Acropolis; taken from Test I, Layer 13 (3, 35).

17. **M-915. Zimbabwe, Rhodesia** 510 ± 150
AD 1440

Charcoal from the highest level, Period IV, and dating the end of the early walling phase and beginning of the period associated with the best quality walling (Type Q), (3, 35).

Sanga series, Congo

Excavations were carried out at Sanga, territory of the Bukama, Katanga Province, Congo. in 1957 by J. Nenquin (38) and the Kisalian culture was isolated on the basis of a typical pottery style, metal working and good evidence for fishing. Very little charcoal was found and the measurements were made from two of the 27 skeletons buried at the site, (39).

18. **B-263. Sanga, Congo** 1240 ± 120
AD 710

The grave goods from this burial (No. 18) included typical Kisalian pottery, iron and a necklace of ostrich eggshell beads (6).

19. **B-264. Sanga, Congo** 1070 ± 200
AD 880

No pottery was found with this burial (No. 10), but the metal objects are similar to the material from other graves containing typical Kisalian pottery, (6).

20. **L-395B. Kalambo Falls, Zambia** 1080 ± 180
AD 870

Charcoal with associated pottery from gray sands and clays near the middle of the Iron Age deposit (6.5 to 7.0 ft. in depth) at Site A1. Since sherds throughout the deposit are essentially of the same type, the sample should roughly date the Channeled Ware culture. Because the date does not indicate the complete time range of the culture at the site, Clark (7) suggests that the culture may extend back to between 1500 and 2000 BP. **Comment** (by the laboratory): The date given is for a sample portion pretreated for humic-acid removal. An untreated portion gave an age of 1010 ± 100 (7). For further information about the

AD 940

site, see Early Stone list Nos. 1-12.

21. **SR-33. Malapati, Rhodesia**1110 ± 100

AD 840

Charcoal from a midden associated with a river-bank kraal site on the Nuanetsi River near the Malapati dip tank (22° 03' S; 31° 25' E) almost due south of Zimbabwe, collected in 1961 by K.R. Robinson. The charcoal was collected throughout the midden which averaged 8 ins. thick and rested on natural earth. It was overlain by 3 to 4 ins. of sandy soil. The midden produced stamped pottery which, although related to the wares of Gokomere and Mabveni, shows new features which Robinson (33, p. 160) suggests may be linked with the pottery believed to have been made by the ancient Kwena who later became known as the Ngwato. The type site of this ware is Maokagani Hill in Bechuanaland (33, 15).

Feti la Choya series, Angola

Feti la Choya, the traditional burial place of Choya, legendary primal queen of the Ovimbundu, near the confluence of the Kuene and Kunyongamua Rivers (13° 26' S; 15° 53' E). Charcoal samples were taken from a large midden, part of a large fortified site containing stone-work and evidence of intensive iron smelting, in a shaft (sunk by treasure hunters) at the south side of the midden. Sterile soil was encountered at a depth of 2.5 m. The Social Anthropology of the Ovimbundu has been described by G.M. Childs (40), who collected the samples (14, 41).

22. **Y-587. Feti la Choya, Angola**1240 ± 100

AD 710

Sample from the bottom layer overlying sterile soil and associated with pottery and faunal remains.

23. **Y-588. Feti la Choya, Angola**700 ± 65

AD 1250

Sample from the lower layer of the midden, about 1.5 m. above the sterile soil in the same shaft as Y-587.

Clark (14) comments that the dates bracket the time of the first stone walling at Zimbabwe.

Isamu Pate series, Kalomo, Zambia

Isamu Pate Mound, 10 miles west of Kalomo, was first investigated in 1960 and 1961 by B.M. Fagan. The mound, formed by ash and accumulated midden refuse of the early Iron Age inhabitants, is some 10 ft. deep and is the type-site for the Kalomo Culture. The excavated material indicates a mixed farming economy with evidence for the hoe-cultivation of Kaffir corn and the keeping of cattle, sheep or goats, and dogs. There was an emphasis on hunting in the earlier stages. Iron working was also practised but on a small scale, and there is evidence for circular huts of the pole and daga type. The Kalomo Culture is considered by Fagan (13) to be derived in part from the Situmpa Culture (= Channelled Ware pottery). Some ten burials were recovered. The following dates have been published with full details: R-874, UCLA-177, UCLA-176, UCLA-175. The other dates in this list (21) are not yet published in detail.

DEACON - RADIO CARBON DATES

24. **SR-19. Isamu Pate, Zambia** 1300 ± 90
AD 650
Sample from bedrock at 117 ins. (21)
25. **R-874 (NZ) Isamu Pate, Zambia** 995 ± 61
AD 955
Sample from 90 ins. depth; charcoal (21). Previously published as AD 967 (42).
26. **UCLA-177. Isamu Pate, Zambia** 960 ± 70
AD 990
Charcoal from the remains of a hearth in Strip 1, Square A5, at a depth of 73 ins. (13).
27. **SR-30. Isamu Pate, Zambia** 930 ± 100
AD 1020
Sample from a depth of 42 ins. (21).
28. **UCLA-176. Isamu Pate, Zambia** 890 ± 70
AD 1060
Charcoal from a burnt log in a hearth in Strip 1, Square B1, at a depth of 40 ins. (13).
29. **UCLA-175. Isamu Pate, Zambia** 710 ± 50
AD 1240
Charcoal from a posthole in Square A2, Strip 1. at a depth of 15 ins. (13).
30. **SR-31. Isamu Pate, Zambia** 900 ± 90
AD 1050
Sample from a depth of 18 in. (21).
31. **SR-20. Isamu Pate, Zambia** 910 ± 100
AD 1040
Sample from a depth of 9-10 ins. (21).

Note: On statistical grounds, Mr. S. Daniels (21) has shown that the 'least improbable chronology' for Isamu Pate covers the period 725 - 1200 AD. For additional information see: 42, 43, 44, 28, 21, 13.

Ingombe Ilede series, Zambia

Ingombe Ilede (16° 10' S; 28° 47' E) is an ash-topped ridge on the north bank of the Zambezi, 32 miles downstream from the Kariba Dam and below the confluence of the Lusitu River. Originally investigated by J. Chaplin in 1960 (17), further excavations were undertaken by B.M. Fagan in 1961 and 1962. A total of 46 individual burials were found, of which 4 in the central area were associated with unusually rich grave goods. The excavations showed some 8 ft. of deposit in which there are significant changes in pottery styles: the earliest pots are rather rough and the later ware consists of shallow, thin-walled bowls and beakers with incised and comb-stamped decoration and graphite burnishing. The inhabitants practised a mixed hunting and farming economy at a time when the tendency was towards greater specialization in domestic stock and agriculture (Fagan, 42).

The four richest burials show a large number of trade goods such as cloth, gold and glass beads, copper bangles, a single copper razor, copper crosses, mpande shell necklaces and leather amulets presumed to be of Arab origin (Fagan (42)). The presence of the other poorly decorated burials has led Fagan (42) to suggest that the settlement may have been a village whose principal inhabitants were engaged in trading, while the common people were the food producers.

32. **SR-23. Ingombe Ilede, Zambia** 1150 ± 100
AD 800

Sample from a depth of 36 ins. (21)

33. **SR-22. Ingombe Ilede, Zambia** 1120 ± 200
AD 830

Sample from a depth of 30 ins. (21)

34. **Q-720. Ingombe Ilede, Zambia** 965 ± 100
AD 985

Wood charcoal submitted as a cross-check with SR-23 (19).

35. **R-908 (NZ). Ingombe Ilede, Zambia** 486 ± 87
AD 1464

Sample from a depth of 90 ins. (21). The date listed here is that published by Fagan in 1963 (42); the sample has also been quoted as AD 680 ± 40 (21).

36. **GrN-3580. Kalambo Falls, Zambia** 930 ± 40
AD 1020

Sample from Site B2, at a depth of 2.10 m. in the Iron Age levels at the Kalambo Falls site. Details of the associations are not yet published (21). Further information about the site is in the Early Stone Age list No. 1-12.

37. **GX-0109. Sebanzi Hill, Lochinvar Ranch, Zambia** 750 ± 135
AD 1200

Sebanzi Hill on the Lochinvar Ranch some 27 miles north-west of Monze in Zambia was excavated in 1963 and 1964. In some 5 ft. 6 ins. of cultural deposit a sequence of pottery styles has enabled the development of Tonga pottery to be traced from the Eleventh through to the Twentieth Centuries. This sample is from the earlier part of the sequence (21, 45).

38. **SR-28. Kamusongolo Kopje Cave, Zambia** 800 ± 100
AD 1150

Charcoal from the Kamusongolo Kopje Cave (13° 27' S; 25° 51' E) near Kasempa, which was excavated by S. G. Daniels of the National Monuments Commission. Overlying a Wilton deposit, the Iron Age levels are associated with comb-stamped pottery (21, 15).

Mutema's Sacred Grove series, Rhodesia

Mutema's Sacred Grove (19° 59' S; 32° 33' E), an Iron Age site, excavated by A. Whitty of the Historical Monuments Commission of Rhodesia. Details of the site and finds have not yet been published (15).

DEACON - RADIO CARBON DATES

39. SR-37. Mutema's Sacred Grove, Melsetter, Rhodesia 800 ± 90
AD 1150

A wood post from below the surface. (15).

40. SR-36. Mutema's Sacred Grove, Melsetter, Rhodesia 720 ± 120
AD 1230

Sample from a wood post found on the surface before the excavation had started (15).

Graniteside series, Salisbury, Rhodesia

The Graniteside Iron Age site ($17^{\circ}50'S$; $31^{\circ}05'E$) was excavated in 1958-1959 to a depth of about $4\frac{1}{2}$ ft. A number of shaft graves were found to contain burial goods such as iron bangles, beads and a large number of whole pots, the majority of which were plain and undecorated. The skeletal material is considered to be non-Bantu, and comparable to the remains from Mapungubwe (10, 46, 18).

41. Y-722. Graniteside, Rhodesia 670 ± 100
AD 1280

Charcoal from inside one of the pots (10).

42. GrN-2341. Graniteside, Rhodesia 680 ± 60
AD 1270

Charcoal from the inside of pots (18).

43. SR-25. Harleigh Farm, Rusape, Rhodesia 650 ± 120
AD 1300

A charcoal sample from carbonized posts overlain by an early floor of the Zimbabwe Culture settlement on Harleigh Farm ($18^{\circ}32'S$; $32^{\circ}05'E$). Collected and submitted by P.A. Robins. This represents a *post quem* date for the settlement (15).

44. GrN-3189. Kalambo Falls, Zambia 370 ± 50
AD 1580

Sample from site B2, depth 60-90 cm. in the Iron Age levels at Kalambo Falls at the southern end of Lake Tanganyika (21). See also Early Stone Age list Nos. 1-12.

Nachikufu Cave series, Zambia

Charcoal from the Iron Age levels at Nachikufu Cave ($12^{\circ}14'S$; $31^{\circ}15'E$). There is evidence for iron smelting in the outer part of the cave and Clark (47) states that the evidence of beads from the earlier excavations suggest at the earliest an 18th century date for the upper part of the occupation. (11, 47). See also Later Stone Age list No. 12-18.

45. Y-618. Nachikufu Cave, Zambia 300 ± 200
AD 1650

Sample collected during 1953 excavations at a depth of 0.5 to 1.0 ft. (11).

46. Y-796. Nachikufu Cave, Zambia 200 ± 100
AD 1750

Sample collected during 1955 excavations at a depth of 2.0 to 3.0 ft. (11).

47. **SR-35. Harleigh Farm, Rusape, Rhodesia**280 $\pm$ 90

AD 1670

A charcoal sample from the same farm as No. 43 above. Collected by J.R. Crawford, the sample was obtained from a pit sealed by deposits of an early occupation of the site and comes from a midden containing pottery of the earliest type found on the site which is the ancestral home of the Chipunza Chieftaincy (15).

Nsongezi Rock Shelter series, Uganda

The Nsongezi Rock Shelter (0° 59' S; 30° 45' E) is situated on the left bank of the Kagera River in the Ankole district of south-west Uganda. The site was first excavated in 1932 by E.J. Wayland, and subsequently in 1935 by T.P. O'Brien and by C. van Riet Lowe in 1937. These samples are from the latest excavations conducted by M. Posnansky and S.V. Pearce in 1961. In 7-8 ft. of deposit the industry is clearly Late Wilton with pottery appearing in the top 4 ft. O'Brien (48) divided the industry into two stages on the basis of the pottery, but C. van Riet Lowe (49) believed the industry to be an homogenous one with pottery throughout. Posnansky and Pearce (50, 52) agreed in general with the conclusions of O'Brien and found a succession of recent pottery, Bigo Culture and later, in the top 3 ft. partly underlain by Dimple-based Ware at 2 to 4 ft. Iron ware in the form of an iron arrowhead, an iron spear-butt and a wrought iron needle were recovered by various excavators in the top 3 ft. of deposit (12, 53) M-1113 provides a date for the Dimple-based pottery of East Africa, but M-1114 appears to have been contaminated with recent carbon.

48. **M-1113. Nsongezi, Uganda**925 $\pm$ 150

AD 1025

Sample from a hearth overlain by brown cave earth much riddled by roots and burrowing animals, 3.5 to 4 ft. thick. The hearth was not more than 6 ins. at its maximum thickness. (12).

49. **M-1114. Nsongezi, Uganda**125 $\pm$ 150

AD 1825

From the 2-4 ft. level and associated with pottery with roulette decoration.

Comment: Sample liable to contamination (12).

50. **Y-570. Lanet II, Nakuru, Kenya**375 $\pm$ 100

AD 1575

Lanet (0° 18' S; 36° 07' E), near Nakuru, was excavated in 1957 by M. Posnansky. The settlement consists of up to 60 earthen hollows dug into the slope of a hill which was surmounted by an irregular triangular shaped enclosure with a 15 ft. high earth bank, suggested by Posnansky (51) to be a large cattle Kraal. Three of the hollows or houses were excavated and the finds consisted of pottery of the Lanet Culture (related to the assemblage from Hyraz Hill (51)) decorated with roulette and single cord motifs, a few stone bowls (similar to the Gumban B), a variety of bone leather dressing tools, but no evidence of iron. The bones of domestic animals were also found. The sample submitted for dating was charcoal from a hearth beneath the ground surface and unlikely to have post-dated the earthworks. (10, 51, 54).

DEACON - RADIO CARBON DATES

51. BM-52. Gaan Nibaah, Somaliland

100 ± 150
AD 1850

Wood from Gaan Nibaah ($9^{\circ} 52' N$; $44^{\circ} 48' E$) found at ground level at the bottom of a mound burial of a type of grave attributed to the pre-Somali inhabitants, the Galla. **Comment:** There are no comparative dates and this one would seem to imply that the grave is recent and probably Somali rather than Galla. Collected in 1957 by I.M. Lewis. (9, 55).

Nok series, Nigeria

Samples from the alluvial deposits exposed in the Main Paddock of the tin mine on the Nok River near Jos, Nigeria. The basal gravels of the youngest alluvial body contain pottery and terra-cotta figurines and some evidence of metal working (1). Fagg (56) states that sample Y-142-4 came from an abraded semi-carbonized tree trunk and assumes it to be therefore earlier than the deposits in which it was found. He therefore dates the figurine culture to the period between about 500 BC and AD 200, bearing in mind that the introduction of iron working is unlikely to have occurred before about 500 BC. The very early date of Y-475 has not been explained, but the sample used may have been derived.

52. Y-475. Nok, Nigeria

4060 ± 140
2110 BC

From site Nok H; carbonized wood from the sand and gravel at the main figurine horizon overlying the basal gravel of the younger alluvial body recovered during the 1956 excavations. (1).

53. Y-142-4. Nok, Nigeria

2875 ± 70
925 BC

From site Nok D; wood from the sand overlying the basal gravel of the youngest alluvial body recovered during the 1951 excavation.

54. Y-474. Nok, Nigeria

1750 ± 50
AD 200

From site Nok G; wood with bark adhering from the black clay overlying the sand and gravel of the youngest alluvial body recovered during the 1956 excavations. (1).

55. GaK-276. Talaky, Madagascar

840 ± 80
AD 1110

Charcoal from 1 mile east of Talaky, Ambany, Tsihombe, Madagascar ($28^{\circ} 28' S$; $48^{\circ} 21' E$) in a fireplace located in square C4 and C5 in Zone B, site 2, 20 cm below the surface. Associated with pottery, iron hooks and other artifacts, the date indicates that iron was known in the beginning of the second millenium in the area. Collected and submitted by P. Vérin. (57, 4).

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C. DATES OF PALAEO-ENVIRONMENTAL INTEREST

Lab. No.	Date B.P. B.C.	Site	Cultural Association	Climate Implication	Evi- dence	Refer- ence
1. GrN-2644	$57,600 \pm 750$ 55,650 BC	Kalambo Falls, Zambia	Late Acheulian	Warmer and drier	Pollen	5
2.	11 dates ranging between >52,000 BP and <22,600 BP	"	Final Acheulian through transi- tional Acheulian/ Sangoan to full Sangoan	Cooler and wetter Warmer and drier Present day temperatures Warm and probably drier Probably cooler and wetter	"	
3. UCLA-168	$38,000 \pm 2500$ 36,050 BC	Mufo, Angola	Sangoan/Lower Lupemban	Open vegetation	"	1
UCLA-169	34,000					
4. Y-103	44,000	Florisbad, South Africa	Early Middle Stone Age	Warmer and drier	"	2
C-850	41,000					
L-271B	35,000		Age			
5. SR-39	$35,530 \pm 780$ 33,580 BC	Pomongwe, Rhodesia	End of Stillbay Middle Stone Age	Wetter	Increased exfoliation	3
6. Lv-44	30,000	Lemba and Basoko R., Congo	Lupemban	Dry period	Erosion	6
Lv-47	30,000					
7. L-3991	$27,500 \pm 2300$ 25,550 BC	Kalambo Falls, Zambia	Lupemban	Warmer and probably wetter	Pollen	5
8. L-271C	$28,450 \pm 2200$ 26,500 BC	Florisbad, South Africa	Middle Stone Age: Peat II	Wetter and drier conditions	"	5
L-271D	$19,330 \pm 600$ 17,580 BC		Middle Stone Age: Peat III	oscillating during period between Peat II and Peat III		
9. UCLA-229	$22,800 \pm 1000$ 20,850 BC	Twin Rivers, Zambia	Middle Stone Age	Cooler and wetter	Traver- tine formation	7
10. C-581	$14,303 \pm 560$ 12,553 BC	Mufo, Angola	Late Upper Lupemban	Cooler but not necessarily wetter	Pollen	7
11. I-556	$14,700 \pm 290$ 12,750 BC	Mahoma Lake, Uganda	Nil	Beginning of the final glacial retreat in the Ruwenzori	Geologi- cal	13
12. GrN-3048	$12,650 \pm 100$ 10,700 BC	Cherangani, Kenya	Nil	Cool period coincident with European Oldest Dryas	Pollen	12
13. L-395D	9550 ± 210 7600 BC	Abercorn, Zambia	Magosian	Cooler and moister	Pollen	5

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Lab. No.	Date $\frac{B.P.}{B.C.}$	Site	Cultural Association	Climatic Implication	Evidence	Reference
14. T-341	7000 ± 100 5050 BC	Kafra, Niger	Nil	End of humid period in the Sahara	Lacus-trinelime-stones	14
T-361	7310 ± 120 5360 BC	Adrar Bous, Niger	"	"	"	"
T-279	6900 ± 150 4950 BC	Kandel Bouzou, Niger	"	"	Moss and water plants	"
15. UCLA-167	6830 ± 120 4880 BC	Mufo, Angola	Tshitolian	Warmer and moister	Pollen	1
16. Y-466	6870 ± 160 4920 BC	Groenvlei, South Africa	Nil	Climate similar to that of today	Pollen and Geological	8
Y-467	1905 ± 60 AD 45			between these dates; followed by wetter conditions		
17. Lv-17	7840 ± 190 5890 BC	Lemba and	Nil	Wetter	Fossil wood	17
Lv-45	6030 ± 190 4080 BC	Mt. Gafula, Congo	Late Tshitolian	"	Erosion	6
18. UCLA-171	4700 ± 100 2750 BC	Calunda, Angola	Tshitolian	Sample too small	Pollen	1
The following additional dates have also been run on cores drilled for studying the pollen sequence, but the details have not yet been published in full. Results from Muchoya Fen, Uganda (see Geological list 17-19) have also not yet been published in full.						
19. GrN-4194	$33,350 \pm 1000$ 31,400 BC	Sacred Lake, Kenya	Nil		Pollen	15
20. GrN-4089	27,750 BP	Cherangani, Kenya	Nil		Pollen	15
21.	$12,650 \pm 200$ 10,700 BC	Aliwal North South Africa	Nil		Pollen	15
22.	9,000 BP	Lake Naivasha, Kenya	Nil		Pollen	15

DEACON - RADIO CARBON DATES

ADDITIONAL NOTES ON PALAEOENVIRONMENTAL DATES

1. GrN-2644. Kalambo Falls, Zambia

$57,600 \pm 750$
55,650 BC

Five samples for pollen analysis were collected and studied by E. M. van Zinderen Bakker from the Late Acheulian levels. These yielded a total sample of 1527 pollen grains (averaging about 305 per sample and ranging from 150 to 424) and the results showed that the Late Acheulian may be correlated with warmer and drier conditions (5). (Clark (18) states that the vegetation was much the same as that of the present day). There are no finite dates for the final Acheulian phase, but Clark (18) has correlated this cultural phase with cooler and wetter conditions (see below). After comparison between the activity of the modern river with regard to the transportation of pollen, and the modern pollen spectra, it was concluded (5) that the river transport of pollen did not have an appreciable effect on the fossil spectra.

2. Kalambo Falls, Zambia

See Early Stone Age list 2-12

Some 15 further samples (see 1 above) for pollen analysis were studied from the Kalambo Falls deposits between the Late Acheulian and Middle Stone Age (27-500 BP) levels. These represent the final Acheulian, the Acheulian/Sangoan transitional industries and the Sangoan cultural phases. Clark (18) has collated the pollen evidence of van Zinderen Bakker (5) to show that during the final Acheulian phase the climate was cooler and wetter, this phase reaching a climax during the transitional cultural period, and then oscillating during the Sangoan from warmer and drier conditions to probably cooler and wetter, to warmer and probably wetter just before the Middle Stone Age levels. These are correlated with the oscillations of temperature during the Middle Wurm period in Europe and the two curves show a good deal of similarity (5). The Kalambo results are based on 15 samples with a total of 2,782 pollen grains (an average of about 185 grains per sample, ranging between 78 and 423 (5)). The 11 dates for the period are not directly related to the pollen samples which can be said to date to between $>52,000$ and $>32,600$ BP.

3. UCLA-168. Mufo, Angola UCLA-169

$38,000 \pm 2500$
36,050 BC
 $> 34,000$

A sample of 100 pollen grains from the Peaty Clay in the Lower Gravels of the Flats Terrace at Mufo shows the vegetation to have been very open with less proof for humid conditions (1) during the Sangoan or Lower Lupemban cultural phase than for the Tshitolian wet phase (see this list No. 15). A single *Podocarpus* pollen grain is present but may have been transported by wind over a long distance. Van Zinderen Bakker (1) considers the sample too small for a definite conclusion to be drawn.

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- | | | | |
|----|--------------------------------|--------|----------|
| 4. | Florisbad, South Africa | Y-103 | > 44,000 |
| | | C-850 | > 41,000 |
| | | L-271B | > 35,000 |

Pollen samples from the Peat I with a early Middle Stone Age industry (see Middle Stone Age list 1-7) and associated with the Florisbad skull show the climate to have been warmer and drier than that of today (2).

- | | | |
|----|----------------------------------|---------------------|
| 5. | SR-39. Pomongwe, Rhodesia | <u>35,530 ± 780</u> |
| | | 33,580 BC |

At the end of the Stillbay Middle Stone Age horizon, Cooke (3) claims evidence for a wetter climate at this period due to increased exfoliation from the roof and walls of the cave. This is possibly substantiated by the work of Bond (4) on the open site of Khami where a study of the size of feldspar grains at various levels in the deposit suggests a period of erosion at the end of the Stillbay. SR-39 dates the top of the layer of granite spalls (layer 13) at Pomongwe.

- | | | |
|----|-----------------------------------|----------|
| 6. | Lv-44. Lemba, Congo | > 30,000 |
| | Lv-47. Basoko River, Congo | > 30,000 |

Studies on the geology of the Stanley-Pool area in the Congo has led de Ploey (6) to suggest, on the basis of evidence for intensive sheet erosion, a semi-arid period covering roughly the time period spanned by the Wurm glaciation in Europe. The two dates above, for the Lupemban cultural phase, fall within this period.

- | | | |
|----|--------------------------------------|----------------------|
| 7. | L-399I. Kalambo Falls, Zambia | <u>27,500 ± 2300</u> |
| | | 25,550 BC |

Analysis of a sample of 150 pollen grains from the Lupemban cultural levels shows warmer and probably wetter conditions (5).

- | | | |
|----|--|----------------------|
| 8. | L-271C. Florisbad, South Africa. Peat II | <u>28,450 ± 2200</u> |
| | | 26,500 BC |
| | L-271D. Florisbad, South Africa. Peat III | <u>19,530 ± 650</u> |
| | | 17,580 BC |

Pollen samples taken from the Peat II to Peat III levels containing Middle Stone Age (Mazelspoort variant) cultural material show oscillating wetter and drier conditions (8). The total sample consisted of at least 950 grains (2).

- | | | |
|----|--------------------------------------|----------------------|
| 9. | UCLA-229. Twin Rivers, Zambia | <u>22,800 ± 1000</u> |
| | | 20,850 BC |

Travertine, incorporating a Middle Stone Age industry, is considered by Clark (7) to have formed as a result of seepage during a cooler and wetter climate.

- | | | |
|-----|----------------------------|---------------------|
| 10. | C-581. Mufo, Angola | <u>14,503 ± 560</u> |
| | | 12,553 BC |

A sample of 306 pollen grains from the peaty clay of the Upper Gravels of the Flats Terrace associated with an Upper Lupemban or Lupembo-Tshitoliian cultural phase, suggests a vegetation growing under cooler but not necessarily wetter conditions than those of today (1).

DEACON - RADIO CARBON DATES

11. I-556. Mahoma Lake, Uganda

$14,700 \pm 290$
12,750 BC

Gyttja dated from the base of a glacial lake and probably indicating the date of retreat of the lowest valley moraines of the Ruwenzori range. The result shows the retreat from the last glacial maximum to have been synchronous with that in Europe and North America (13).

12. GrN-3048. Cherangani, Kenya

$12,650 \pm 100$
10,700 BC

Pollen analysis of a core drilled in a swamp in the Cherangani Hills indicates a cold period at the level dated. Van Zinderen Bakker (12) suggests coincidence with the Oldest Dryas in Europe, while on the basis of the rate of sedimentation and the oscillations in temperature indicated by the changing pollen spectra he concludes that the 'Gamblian' pluvial is coincident with the Wurm glaciation in Europe (11).

13. L-395D. Abercorn, Zambia

9550 ± 210
7600 BC

This sample is apparently from the Kalambo Falls sequence (see Clark and Van Zinderen Bakker (5) Fig. 1 and Table 2) and analysis of four pollen samples with a total of 924 pollen grains has suggested a cooler and moister climate at the Magosian Second Intermediate level.

14. T-341. Kafra, Niger

7000 ± 100
5050 BC

- T-361. Adrar Bous, Niger

7310 ± 120
5360 BC

- T-279. Kandel Bouzou, Niger

6900 ± 150
4950 BC

Evidence from lacustrine sediments in what is now a desert area for a wetter period. These dates mark the end of that period.

15. UCLA-167. Mufo, Angola

6830 ± 120
4880 BC

A sample of some 450 pollen grains from the peaty clay in the sands and gravels overlying the Upper Gravels of the Flats Terrace and associated with Tshitolian cultural material, indicates a climate which must have been generally warmer and moister than the present (1).

16. Y-466. Groenvlei, Knysna district, South Africa

6870 ± 160
4920 BC

- Y-467. Groenvlei, South Africa

1905 ± 60
AD 45

Work by Martin (16) in fen deposits at Groenvlei show marine mud intercalated in freshwater deposits indicating a higher sea level falling between the two dates above which are from the freshwater deposits above and below the marine mud. Pollen analysis shows that heath vegetation (similar to that of today) predominated until the return of the fresh water conditions when wetter conditions favoured the establishment of coastal woodland (8).

17. **Lv-45. Mt. Gafula, Congo** 6030 ± 190
4080 BC

On the basis of observations of linear erosion, de Ploey (6) recognises a period of increased rainfall during Tshitolian times in the Stanley-Pool area.

- Lv-17. Lemba, Congo** 7840 ± 190
5890 BC

A sample of fossil wood collected from a dried-out fen indicating that the site, at present a desert, was occupied by equatorial forest (17).

18. **UCLA-171. Calunda, Angola** 4700 ± 100
2750 BC

Analysis of a sample of 50 pollen grains from peaty clays of the Lower Stream Gravels exposed just below water level showed a spectrum typical of a riverine forest vegetation found today at a slightly higher altitude than Calunda, however, the sample is considered to be too small to allow any definite conclusions (1).

Note: The numbers of pollen grains counted in the palynological samples above are given as a measure of the reliability that can be placed on the climatic deductions that have been made. It is evident from the sources quoted that when there are fewer than 100 grains, the sample is considered too small by the analyst to allow definite conclusions to be drawn. (In Britain, 150 tree pollen grains and in the absence of many trees, 400 pollens from land plants, are considered to constitute a reliable sample (Dr. S. Seagrief, pers. comm.)).

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SUMMARY AND CONCLUSIONS

A total of 21 laboratories have processed dates from sub-Saharan Africa and these are listed, with the numbers of dates run by each tabulated according to region, in Table 2. Yale and the recently established laboratory in Salisbury (the only one in Africa) have been most active.

The regional and cultural distribution of the dates is tabulated in Table 1. This shows that Central Africa has the largest number of dates - almost three times as many as South Africa which has the next highest number - and to be the only region with dates from all cultural stages.

Several papers have appeared during the last few years correlating the results of radiocarbon dates in various parts of the world. Jelinek (1) has published an analysis of archaeological dates for the New and Old Worlds published to the end of 1961 and in a series of histograms has recognized apparently significant gaps in the time range. In comparing Fig. 2 of this paper with these results, however, any gaps that do appear are undoubtedly due to sampling as there are as yet too few dates from Sub-Saharan Africa. The most significant similarity between the two sets of histograms would be the rise in the numbers of processed dates with the advent of food production (Iron Age in Africa).

A review of the radiocarbon dates published up to 1959 for sub-Saharan Africa has appeared by Clark (11) whose conclusions are broadly confirmed here. Additional papers on the carbon dates from this region from c. 1000 B. C. to the present have been published in the *Journal of African History* by B. M. Fagan.

Section A of the date list deals with the geological and tree-ring determinations and these require little comment. It is clear that only a start has been made on using the potentialities of the Carbon-14 method for the study of the recent geological histories of, for example, the coastal and inland lakes where old shore lines and related deposits not infrequently contain datable material.

Section C has been compiled largely from dates from the other sections and lists those sites at which evidence has been found for climatic variation. A result of 12,750 B. C. (I-556) has been obtained for the retreat of the last glacial maximum in the Ruwenzori Range in East Africa, while work by Van Zinderen Bakker in the Cherangani Hills of East Africa and elsewhere has corroborated this evidence suggesting that temperature changes evident from differences in vegetation patterns have been broadly synchronous with the stages of the Wurm glaciation in Europe. Detailed discussions of Pleistocene vegetation patterns and cultural development are given in papers by Clark (2) and Van Zinderen Bakker (3). It is obvious, however, that a lot more evidence is needed before a well-dated climatic sequence can be drawn up for the last 50,000 years in Africa, especially as it appears (comparing evidence from the Congo basin cited by de Ploey (9) with that from north-east Angola (Van Zinderen Bakker, 5)) that local regions may have offered differential responses in terms of total climate to apparently world-wide temperature fluctuations.

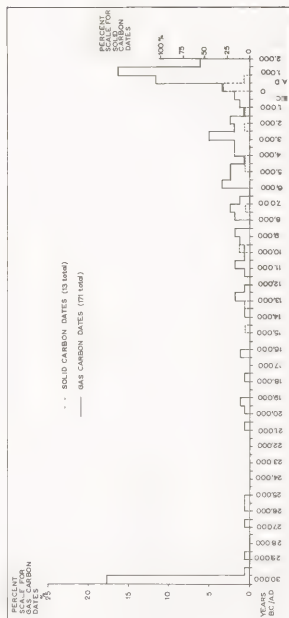


FIG. 2 HISTOGRAM SHOWING TEMPORAL DISTRIBUTION OF 184 RADIOCARBON DATES FROM SUB-SAHARAN AFRICA. Where two dates have been published for a single sample (as where chemically fractionated) both dates have been plotted.

Figure 3 shows to what extent the successive cultural stages in sub-Saharan Africa can be defined in terms of absolute time. Attempts to date the final stages of the Chelles-Acheul culture of the Early Stone Age suggest it to be outside the time range of the standard laboratory method. A single enrichment date for the Late Acheulian at Kalambo Falls (GrN-2644) of 55,650 B.C. gives the only finite result, which, because of the limitations of the enrichment process, should be regarded as a minimal date. With determinations from only two sites, Kalambo Falls and Nok, and the latter a geological context, the terminal stages of the Early Stone Age are poorly defined.

Within the limited geographical area of Central Africa, the Sangoan industries of the First Intermediate are fairly well dated within a small temporal range between 32,600 (GrN-3608) and 49,000 (GrN-3211). Nine of the eleven determinations are from Kalambo Falls and the other two are from Pomongwe. If one accepts the apparently uncertain cultural affinities of GrN-3228 as being Sangoan, the finite dates fall between 35,950 B.C. (GrN-3228) and 44,150 B.C. (GrN-3226). The temporal relationship of the Sangoan and Proto-Stillbay cultures in Rhodesia is not clear and it remains to be seen whether, on typological grounds the recognition of two separate cultural stages is warranted. The apparent temporal overlap of the Sangoan or Proto-Stillbay at Pomongwe with the Sangoan industries at Kalambo Falls may suggest that the Proto-Stillbay falls within the range of variation of the First Intermediate cultures (cf. Cooke (6)).

The supposed temporal equivalent of the Sangoan culture in the grasslands area, the Fauresmith culture, remains un-dated. The earlier levels of Florisbad dated at 44,000 B.P. (Y-103) may relate to a First Intermediate industry rather than the Middle Stone Age, but the excavated sample is apparently too small and the assemblage inadequately described.

The 25 dates for the Middle Stone Age are unevenly scattered between 2450 B.C. (BM-34) and 44,000 B.P. (Y-103). Some of the older dates in this series appear to be associated with transitional industries which may be considered as falling either in the First Intermediate or the early part of the Middle Stone Age. These include Florisbad Peat I, Mufo in Angola where UCLA-168 and UCLA-169 were described first by Clark (4) as Lupemban and later (5) as Sangoan/Lower Lupemban, and Pomongwe in Rhodesia where Cooke (6) is uncertain as to whether SR-9 and SR-39 should be regarded as Proto-Stillbay or Stillbay. While the arbitrary typological distinction between the First Intermediate and Middle Stone Age has been the subject of some discussion (MacCalman (7)) it does seem as if the Middle Stone Age in *sensu stricto* was everywhere later than 40,000 years B.P. The apparent reluctance of the excavators to label the industries as either First Intermediate or Middle Stone Age does, however, indicate that the Middle Stone Age technological innovations were apparently already manifest in Rhodesia by 40,250 B.C. (SR-9) and in North-east Angola by 36,050 B.C. (UCLA-168).

Of the younger dates in this range, the Florisbad determinations of 7154 B.C. (C-851) and 4750 B.C. (C-852) were considered to have been contaminated

DEACON - RADIO CARBON DATES

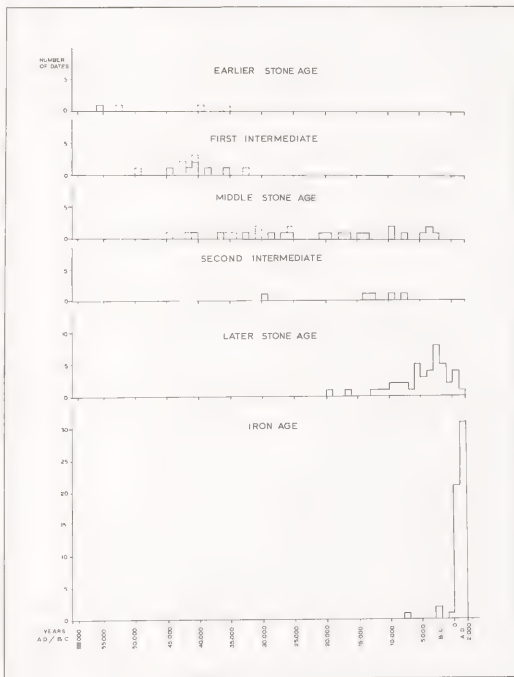


FIG. 3. SERIES OF HISTOGRAMS SHOWING TEMPORAL RANGE OF RADIOCARBON DATES IN SUB-SAHARAN AFRICA FOR THE SIX CULTURAL PHASES. Geological dates are excluded. Dotted lines indicate dates expressed in 'greater-than' values (>).

and later dates from the same levels gave much older results. The Nok and Zenebi determinations from West Africa, while consistently recent at 3625 B.C. (Y-142-3) and 3490 B.C. (Y-142-7), are from a geological context and the dating of the Middle Stone Age in West Africa requires further check dates from archaeological contexts. The date from Holley Shelter in Natal at 2540 B.C. (BM-34) is, both by virtue of its anomalously early position in the time sequence and because of the discrepancy of almost 14,000 years between it and BM-30 from the immediately underlying 6-inch spit, hardly sufficient evidence to support a late survival of the Middle Stone Age in the southern region of South Africa.

The Cave of Hearths series is not internally consistent, and it would be expected that a greater time interval separates the Earlier and Later Pietersburg which Mason (8) has shown are typologically distinct.

The chronology is not sufficiently complete at this stage to be more than indicative that the Lupemban industries of the forest areas and the Stillbay-Pietersburg industries of the grasslands are broadly contemporaneous. The north-east Angolan series, in part from geological contexts, points to the Lupemban developing from about 38,000 years B.P. to about 14,000 years B.P. This is consistent with dates from various sites in the Congo Basin and Kalambo Falls. At Pomongwe, the Stillbay dates approximately between 36,000 years B.P. and 16,000 B.P., while the Cave of Hearths centres around 13,000 years B.P. The determinations from Florisbad Peat II and III, BM-30 from Holley Shelter, and those from Olieboompoort and Twin Rivers all fall within the time range for the Stillbay/Pietersburg as indicated by the longer series of dates from Pomongwe and the Cave of Hearths.

There are only 5 dates from Second Intermediate contexts. The charred ostrich eggshell material from Kisese has given results, which, by comparison with other determinations, are too old by a factor of almost 2, so that NPL-38 dating the Second Intermediate levels at 29,530 B.C. is suspect and must be rejected. The Mufo dates may relate to the Second Intermediate or to the early part of the Later Stone Age as C-581 at 12,553 B.C. has been described as either Late Upper Lupemban (4) or Lupembo-Tshitoliian (5) and would possibly represent a very early stage of the Second Intermediate. C-580 dated to 9239 B.C. has been called either Lupembo-Tshitoliian or Lower Tshitoliian and would therefore fall at the end of the Second Intermediate cultural sequence. So that, apart from the Magosian dates from Pomongwe and Abercorn it would seem that there are too few dates to delimit this cultural period accurately.

There are more significant numbers of dates for the Later Stone Age (total 44) and the Iron Age (total 56) so that the temporal range can be discussed with more assurance and the anomalous dates become more obvious by their isolation on the histogram.

With the Later Stone Age, Ishango at 19,050 B.C. (W-283) is rejected by the laboratory on the grounds of contamination, and the Kisese dates at 16,210 B.C. (NPL-37), 12,810 B.C. (NPL-35) and 8770 B.C. (NPL-36) are also suspect.

DEACON - RADIO CARBON DATES

There are two determinations over 10,000 B.C. which appear reliable - from the Lower Tshitoliian horizon at Calunda, Angola, and from the ?lower Wilton scraper industry at Tshangula in Rhodesia (UCLA-629). Between 5,000 and 10,000 B.C. there are some 12 determinations of which 5 are from the Kasama and Nachikufu series which are considered by the excavator to be anomalously old, one from Kisesec, and another is the younger date for the scraper industry underlying the Wilton at Pomongwe (SR-13: 5740 B.C.). The laboratory and excavator consider this latter date should be rejected in favour of the older date from twig charcoal from the same levels which is dated at 7450 B.C. (SR-12). The five other determinations are from the Wilton and pre-Wilton at Pomongwe and from the Matjes River series. An extrapolated date for Ishango would also fall within this time range. The bulk of the Later Stone Age determinations, however, fall between 4000 B.C. and 1000 A.D., while the most recent date of 1050 A.D. (BM-42) from Olieboompoort attests to the late survival of the Stone Age in South Africa.

The Later Stone Age technology can therefore be said to have developed some 12,000 years ago and to have reached its full expression by about 4000 B.C.

The bulk of the Iron Age results fall between the first and second millennia A.D. Further excavations at Uitkomst Cave, which gave a date of 7894 B.C. (BM-number not published) for the Iron Age horizon in Bed 2 have shown this to be anomalous due to sampling and the result may be rejected from the Iron Age list. A check excavation after the date of 2128 B.C. (C-662) from the early Iron Age site at Situmpa Forest in Zambia again suggests in a re-determination of A.D. 96 (C-829) that the earlier date may be discounted. The unusually early dates from Nok at 2110 B.C. (Y-475) and 925 B.C. (Y-142-4) appear to be anomalously early against the rest of the Iron Age dates and further checking from archaeological contexts is necessary.

The radiocarbon dates clearly show, however, that the Iron Age peoples had penetrated well south into Africa early in the first millenium A.D. They were established in Rhodesia in the first half of this millenium and as far as can be seen at this stage, appeared south of the Limpopo at least as early as 1000 A.D. More Iron Age dates from East and Equatorial Africa are undoubtedly needed to fill out the information we have on the spread of Iron Age technology south of the Sahara.

The general results available thus far are encouraging and have given a measure of the range of time occupied by the successive broad sub-divisions of the cultural sequence in sub-Saharan Africa. However, the detailed chronology of industries within this broad framework in most regions is sketchy and many more dates are needed before the full potential of the Carbon-14 method is exploited.

At present too much reliance is perforce placed on a few relatively well-dated sequences and confirmation of such results from other sites is clearly desirable. Apart from such confirmation of results which have already been

received, however, two other significant points emerge from the dates reviewed here which should be borne in mind when new samples are submitted for dating: firstly, a large series of dates is needed before a cultural phase can be accurately dated even in a limited geographical area; and secondly, the excavator should be certain of the cultural associations of the sample submitted for dating as a tendency has been noted for the culture to be fitted to the date rather than the date to the culture and such uncertainly associated determinations often become more misleading than useful. As pointed out by Movius (12) in discussing radio-carbon dating as an invaluable archaeological method: "but like all fine tools this one must be kept sharp, and handled with care and perception: the most promising excavation site cannot possibly be expected to yield results without the brain, hand and eyes of the excavator".

ACKNOWLEDGEMENTS

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TABLE 1
 NUMERICAL ANALYSIS OF RADIOCARBON DATES FOR SUB-SAHARAN AFRICA
 BY REGION AND ASSOCIATION

	Geological/ Botanical	Early Stone Age	First Intermediate	Middle Stone Age	Second Intermediate	Later Stone Age	Iron Age	Total
South Africa	9	-	-	14	-	9	6	38
Central Africa	6	3	11	9	4	31	42	106
East Africa	8	-	-	-	1	4	4	17
West Africa	10	1	-	2	-	-	2	15
Other	3	-	-	-	-	-	2	5
TOTAL	36	4	11	25	5	44	56	181

DEACON - RADIO CARBON DATES

TABLE 2.

LIST OF LABORATORIES WITH ADDRESS AND CODE LETTERS, FOLLOWED BY
NUMBERS OF DATES PROCESSED FOR SUB-SAHARAN AFRICA
TO 1964 INCLUSIVE

Code Letters	Laboratory	South Africa	Central Africa	East Africa	West Africa	Other	Total
B	Universitat Bern, Bern, SWITZERLAND		2				2
BM	British Museum, London, ENGLAND	6	1	1			8
C	University of Chicago, Illinois, U. S. A.	8	8				16
GaK	Gakushuin University, Mejiro, Toshima-ku, Tokyo, JAPAN					2	2
GL	Geochronological Laboratory Institute of Archaeology, London, ENGLAND		1				1
GrN	Natuurkundig Laboratorium der Rijks-Universiteit, Groningen, NETHERLANDS		11	1			12
GX	Geochron Laboratories Inc. Cambridge, Mass. U.S.A.		1				1
I	Isotopes Inc. Westwood, New Jersey, U. S. A.			1			1
L	Lamont Geological Observatory Columbia University, Palisades, New York, U. S. A.	7	9				16
Lv	Centre de Physique Nucleaire, Av. Cardinal Mercier, Heverle Louvain, BELGIUM		4				4
M	University of Michigan, Ann Arbor, Michigan, U.S.A.		5	2			7
NPL	Applied Physics Division National Physics Laboratory Teddington, Middlesex, ENGLAND			7			7
Q	University Sub-Department of Quaternary Research, Botany School, Cambridge, ENGLAND		1			2	3
R	Radiocarbon Dating Laboratory University of Rome, Citta Universitaria, Roma, ITALY	1					1
R(NZ)	Institute of Nuclear Sciences Lower Hutt, NEW ZEALAND		2				2
SR	University College of Rhodesia and Nyasaland Salisbury, RHODESIA	4	29				33
T	Radiocarbon Dating Laboratory The Norwegian Institute of Technology, Trondheim, NORWAY				7		7

¹ Total 178 as three of the dates have been published without their laboratory numbers.

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TABLE 2 (cont.)

Code Letters	Laboratory	South Africa	Central Africa	East Africa	West Africa	Other	Total
U	Institute of Physics						
	University of Uppsala						
	Uppsala, SWEDEN				3		3
UCLA	Institute of Geophysics						
	University of California						
	Los Angeles 24, U. S. A.		13				13
W	U. S. Geological Survey						
	Washington 25 DC, U. S. A.	1	2	1			4
Y	Radiocarbon Laboratory						
	Yale University						
	New Haven, Conn. U. S. A.	11	14	4	5	1	35
TOTAL		38	103	17	15	5	178

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Distribution of Animals on
Rock-Engravings in the
Northern Cape

Over the last few years a trend to establish game reserves on privately-owned land has been noticeable. Farm-owners are becoming increasingly game-conscious and stocking their farms with a variety of game. R. C. Bigalke and J. A. Bateman published a review of the present situation under the heading: "On the status and distribution of ungulate mammals in the Cape Province, South Africa". This short paper attempts to give the distribution in 12 Districts in the Northern Cape as recorded on rock-engravings by hunter-gatherers of ages past.

As we have every reason to assume that no drastic climate changes occurred in this area during the past 10,000 years - an assumption which is based on climatological and archaeological evidence - the area under review has been semi-arid and the indigenous vegetation more or less the same as prevails today. The prehistoric rock-engravings for which the area became famous, especially after the publication of Maria Wilman's "The Rock-engravings of Griqualand West and Bechuanaland, South Africa" in 1933, are very naturalistic with the exception of the most recent ones. One is therefore able to distinguish between blue and black Wildebeest, Bushpig or Warthog etc. Only in the De Aar District did I come across engravings of animals which one can only identify as "Antelope" without being able to determine the species. This district shows clearly that giraffe were extremely rare, although elephant, rhinoceros and hippopotamus were common.

Most of the sites were visited by the author himself and only in a few instances did he rely on information contained in published references and copies of rock-engravings housed in the McGregor Memorial Museum. The latter collection dates back to G. W. Stow the oldest copies having been made nearly a century ago. A total of 69 sites with engravings were examined. These are mainly situated in the vicinity of rivers or open water.

As some of the more plentiful smaller buck are rarely represented, one can assume that the artists did not indiscriminately depict anything they saw but used their discretion and a materialistic view might have been prevalent, e.g. there is much more flesh on an eland than on a springbok. The eland is by far the most

frequently and most artistically depicted game. While there may have been other reasons for the frequency in which eland are portrayed I would like to suggest their actual abundance in the Northern Cape had a bearing on this.

The following lists are not made up in respect of actual numbers depicted on the various sites (e.g. even if 10 eland occurred on rock-engravings this animal is only listed once in a district), but are intended as an indication as to the type of animal present at that time which was found to be worth recording by the artist.

Animals recorded in:

BARKLY WEST (4 sites): Antbear, baboon, eland, elephant, duiker, gemsbok, giraffe, hartebeest, hippo, lion, ostrich, roan antelope, rhino, springbok, steenbok, tortoise, (blue and black) wildebeest, zebra.

BRITSTOWN (2 sites): Eland, elephant, gemsbok, giraffe, kudu, lion, ostrich, quagga, rhino, warthog, zebra.

COLESBERG (1 site): Blesbok, eland, rhino.

DE AAR (6 sites): Antbear, baboon, blesbok, bushpig, eland, elephant, feline, fish, gemsbok, giraffe, hartebeest, hippo, hyena, jackal, kudu, ostrich, quagga, rhino, rooi ribbok, roan antelope, springbok, warthog, black wildebeest, zebra, several bucks unidentified.

HAY (2 sites): Blesbok, eland, giraffe, jackal, ostrich, rhino.

HERBERT (7 sites): Antbear, eland, giraffe, hartebeest, hippo, kudu, jackal, quagga, rhino, zebra.

HOPETOWN (3 sites): Buffalo, bushpig, eland, elephant, hartebeest, hippo, kudu, lion, ostrich, warthog, zebra.

KIMBERLEY (16 sites): Antbear, baboon, buffalo, crane, duiker, eland, elephant, gemsbok, giraffe, hartebeest, hippo, hyena, jackal, kudu, lion, mon-goose, ostrich, quagga, roan antelope, rhino, rooi ribbok, springbok, warthog, (blue) wildebeest, wild dog, zebra.

POSTMASBURG (5 sites): Baboon, eland, feline, giraffe, jackal, kudu, ostrich, quagga, zebra.

TAUNG (2 sites): Baboon, buffalo, bushpig, eland, elephant, gemsbok, giraffe, hartebeest, hippo, jackal, ostrich, rhino, warthog, zebra.

VRYBURG (16 sites): Antbear, baboon, blesbok, buffalo, crane, eland, elephant, gemsbok, giraffe, hare, hartebeest, hippo, hyena, jackal, kudu, feline, mon-goose, ostrich, quagga, roan antelope, rhino, secretary bird, springbok, tortoise, warthog, (black and blue) wildebeest, wild dog, zebra.

WARRENTON (2 sites): Antbear, bushpig, eland, giraffe, hippo, ostrich, quagga, rhino, rooi ribbok, (blue) wildebeest.

FOCK - ANIMALS ON ROCK ENGRAVINGS

List of the distribution of 38 different animals in 12 Districts
(69 sites) in order of frequency:

Animal	Number of sites	%
Eland	52	11.88
Rhinoceros	35	8.04
Ostrich	32	7.30
Giraffe	24	5.48
Elephant	22	5.00
Gemsbok	21	4.78
Zebra	20	4.56
Antbear	19	4.34
Hartebeest	18	4.10
Feline	17	3.88
Hippopotamos	15	3.42
Quagga	15	3.42
Blue Wildebeest	14	3.20
Black Wildebeest	12	2.73
Warthog	12	2.73
Kudu	11	2.51
Roan antelope	11	2.51
Jackal	9	2.05
Buffalo	8	1.82
Bushpig	8	1.82
Horse	8	1.82
Wild Dog	6	1.36
Baboon	5	1.14
Hyena	5	1.14
Springbok	5	1.14
Tortoise	5	1.14
Blesbok	4	0.91
Crane	3	0.69
Duiker	3	0.69
Mongoose	3	0.69
Rooi Ribbok	3	0.69
Fish	3	0.69
Secretary bird	2	0.46
Sheep	2	0.46
Steenbok	2	0.46
Bustard	2	0.46
Hare	1	0.23
Springhare	1	0.23

**Distribution of animals on rock-engravings compared with present day occurrence
(in brackets) according to J. A. Bateman and C. R. Bigalke**

DISTRICT	Barkly West	Brits town	Coles burg	De Aar	Hay	Her- bert	Hope- town	Kimber- ley	Post- masburg	Vry- burg
Antbear	x(x)	-(x)	-(x)	x(x)	-(x)	x(x)	-(x)	x(x)	-(x)	x(x)
Blesbok	-(x)	-(x)	x(x)	x(x)	x(x)	-(x)	x(-)	-(x)	-(x)	x(x)
Bushpig	-(x)	-(x)	-(x)	x(-)	-(x)	-(x)	x(-)	-(x)	-(x)	-(x)
Duiker	x(x)	-(x)	-(x)	-(x)	-(x)	-(x)	-(x)	x(x)	-(x)	-(x)
Eland	x(x)	x(-)	x(-)	x(-)	x(x)	x(x)	x(-)	x(x)	x(x)	x(x)
Gemsbok	x(-)	x(-)	-(x)	x(-)	-(x)	-(x)	-(x)	x(x)	-(x)	x(-)
Harte- beest	x(x)	-(x)	-(x)	x(-)	-(x)	x(x)	x(-)	x(x)	-(x)	x(x)
Kudu	-(x)	x(-)	-(x)	x(-)	-(x)	x(x)	x(x)	x(x)	x(x)	x(x)
Springbok	x(x)	-(x)	-(x)	x(x)	-(x)	-(x)	-(x)	x(x)	-(x)	x(x)
Steenbok	x(x)	-(x)	-(x)	-(x)	-(x)	-(x)	-(x)	-(x)	-(x)	-(x)
Warthog	-(x)	x(-)	-(x)	x(-)	-(x)	-(x)	x(-)	x(-)	-(x)	x(x)
Black Wil- debeest	x(-)	-(x)	-(x)	x(-)	-(x)	-(x)	-(x)	x(x)	-(x)	x(-)

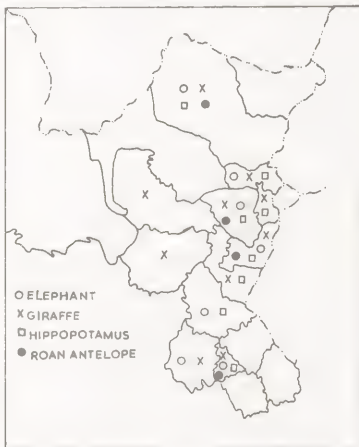


MAP I - Key Map showing the 12 districts under review

FOCK - ANIMALS ON ROCK ENGRAVINGS

Two Districts (Taung and Warrenton) not listed by Bateman and Bigalke were also left out in the above survey.

A comparison between animals found on engravings and their present occurrence is given in the above table. Since proto-historic and historical-times the following animals became extinct in the Northern Cape and are therefore not listed (their one time distribution appears on 2 special maps): buffalo, elephant, giraffe, hippopotamus, quagga, rhinoceros, roan antelope and zebra. Judging from the engravings - the youngest of which are about 150 to 200 years old - all these animals still existed at the beginning of the 19th century. This assumption corresponds with the reports of the early travellers and hunters. During the 19th century the quagga became extinct and other animals probably migrated northwards due to the activities of farmers, miners, and mainly hunters (which included to no small extent Griquas and Koranna). The smaller buck although not represented on



MAP II - One time distribution of animals no longer occurring in the Northern Cape.



MAP III - One time distribution of animals no longer occurring in the Northern Cape.

the engravings but still occurring today are, of course, indigenous game. The other, big game animals, like eland, gemsbok, kudu and wildebeeste always found the Northern Cape a suitable habitat as is proved by their successful re-introduction in recent times. When introducing game into a certain area it might be expedient to ascertain also from rock-engravings in the vicinity whether such animals were at any stage prevalent there as rock-engravings in some instances date back several thousand years.

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SIDGE and R. M. TIETZ
PORT ELIZABETH MUSEUM

A record of *Beradius arnouxii*
from the South-East Coast of
South Africa

ABSTRACT

The occurrence of *Beradius arnouxii* in South African waters is recorded and descriptions of external features and cranial characters are given. Body and skull proportions are compared with those of other specimens of *B. arnouxii* and also with those of *B. bairdi*. These comparisons show that the two species resemble one another closely and that the main ground for their separation is the great distance between their distribution areas: *B. arnouxii* being restricted to Southern seas while *B. bairdi* has a northern distribution.

INTRODUCTION

In Professor Flower's account of the recent Ziphioid Whales (1874) he points out that "Their very presence in the Ocean seems to pass unnoticed and unsuspected by voyagers, and even by those whose special occupation is to capture the various better known cetaceans, until an accidental occurrence reveals the existence of forms of animal life of considerable magnitude and at least sufficiently numerous to maintain the continuity of the race". In spite of subsequent strandings of Beaked whales in various and distant parts of the world resulting in the descriptions of more genera and species of the Ziphiidae these words hold true today for although we know more about the taxonomy and the skeletal structure of the Beaked Whales, our knowledge of their distribution is incomplete and their habits are almost entirely unknown.

Occasionally members of this group are found stranded on the shores of Southern Africa and the Port Elizabeth Museum has been extremely fortunate in acquiring records of all the genera represented in South African Waters. In February, 1907 a specimen of *Mesoplodon layardi* was washed up at the mouth of the Zwartkops river while 3 years later in April, 1910 *Mesoplodon grayi* was found stranded near Cape Recife. We hold two records for *Mesoplodon densirostris*: one from Cape Recife in April, 1952 and one from Jeffery's Bay in January, 1953. We are now pleased to report the addition of another genus to our list, a first record for Southern Africa. It is interesting to note in passing that all strandings of Beaked Whales on South African Shores have taken place during the warmer summer months (personal communication with Peter Best of S. A. Museum) with the exception of a specimen of *Mesoplodon mirus* which was

stranded in May, 1959 at the Wilderness (Talbot 1960).

On the 31st December, 1962 Mr. D. Taylor reported the stranding of a "Porpoise Whale" two miles west of the Kromme River Mouth, Jeffery's Bay. On New Year's Day Dr. G.R. McLachlan and Mr. R. Liversidge of the Port Elizabeth Museum travelled out to inspect, measure and identify the specimen and to secure the skull and Mandible for the Museum.

EXTERNAL FEATURES

The whale was an adult male 30'6" in length and was reported to be wholly black in colour. It was assumed that this animal had not been dead more than two to three days and that the extreme darkness of colour had developed after death as we have observed with other cetacean strandings.

The head bore a prominent forehead and the lower jaw projected approximately 3" beyond the snout. Only two large teeth were visible in the mandible at its distal end and of these the crown of the right one was badly chipped. Unfortunately the skin and flesh of the throat had been cut away so that the throat grooves so characteristic of the Ziphiidae were not discernable. Apart from this gash there was no external wound but the skin was lacerated and there were a few blisters. The flukes with a span of 8'6", did not show a median notch, a feature common to the Ziphiidae but there was a slight indentation medially. The flipper was about $\frac{1}{4}$ of the body length while the dorsal fin was most insignificant being only about 5 $\frac{1}{2}$ " high and without the concave emargination posteriorly as in other Cetaceans. Table 1 shows the external measurements and their percentage of total length of the specimen as compared with the same figures for a 29' adult female *Berardius arnouxii* stranded on the coast of South Australia (Hale, 1962).

TABLE 1
BODY PROPORTIONS OF *BERARDIUS ARNOUXII*

	male		female	
	mm	%	mm	%
Total length	9296	100	8845	100
Tip of snout to vertical level of anterior corner of eye	914	9.83	915	10.3
Tip of snout to blowhole	1143	12.3	1040	11.7
Tip of mandible to vertical level of anterior corner of eye	990	10.6	864	9.7
Projection of lower jaw beyond tip of snout	76	0.82	51	0.5
Tip of snout to vertical level of anterior end of base of dorsal fin	5892	63.37	5871	66.3
Tip of snout to axilla	1727	18.57	1982	22.4
Length pectoral flipper (axilla-tip)	736	7.91	787	8.9
Width of flukes	2590	27.86	2238	25.3
Height of dorsal fin	149	1.6	153	1.7

McLACHLAN, LIVERSIDGE & TIETZ - A RECORD OF BERARDIUS ARNOUXI

The measurements and body proportions of the 2 specimens are comparable justifying the identification of the South African Specimen as *Berardius arnouxii*. Further the dimensions shown here shed no light on possible sexual dimorphism in this species. Among the Ziphioid Whales the male is usually the larger and in this case the adult male is only slightly larger than the adult female discrediting the statement of Slipp and Wilke (1953) that the usual Ziphiid size relationship between the sexes is apparently reversed in *Berardius*.

The relative size of the South African specimen as compared with the smaller *Hyperoodon* and *Mesoplodon*, the prominent *melon*, or forehead and the projecting lower jaw bearing teeth distally leave no doubt that it belongs to the genus *Berardius* Duvernoy 1851.

At present two species of *Berardius* are recognised in literature and as the two resemble one another very closely the distinction seems to be based on their distribution alone. The Genotype, *Berardius arnouxii* shows a Southern distribution having been taken from New Zealand (Flower 1874), South America (Marelli, 1920) and South Australia (Hale 1939) while *Berardius bairdi* has been recorded from the North Pacific; Behring Island, St. George Island, California (True 1910), Japan (Omura, Fujino & Kimura, 1955) as well as from the North Atlantic at Ocean City (Slipp & Wilke, 1953).

Records show that *Berardius bairdi* is consistently the larger species: a 42' female from St. George Island, Alaska (True 1910) a 34' female from Ocean City (Slipp & Wilke, 1953), a 33' male from British Colombia (Pike 1953) and a 36' female from Japan (Omura, Fujino and Kimura, 1955) while the specimens of *Berardius arnouxii* do not measure up to these lengths: a 27' specimen from New Zealand (True 1910), a 30'6" specimen from New Zealand (Flower 1874) and a 29' female from South Australia (Hale, 1939).

Both in its Southern distribution and in its size the 30'6" South African specimen falls within the limits for *Berardius arnouxii*. Hale (1962) quoting Omura Fujino and Kimura (1955) has suggested that this constant difference in size between the two species is a result of a fore-shortening of the caudal region due to smaller caudal vertebrae in *B. arnouxii*.

Other distinguishing features between the two species have been noted from time to time. True (1910) observed that in *B. bairdi* the flukes were wider, the pectoral flippers longer and the dorsal was higher. (Table 2) shows these proportions for 3 specimens of *B. bairdi* and three specimens of *B. arnouxii* indicates that, contrary to the opinion held by True (1910) and in accordance with Hale's (1962) conclusion the span of the flukes (being the measurement from tip to tip) in both species of *Berardius* is comparable. Further, the dorsal fin originally thought to be higher in *B. arnouxii* than in *B. bairdi* cannot be used as a criterion for though it is high in the New Zealand specimen it is considerably lower in both the South African and South Australian adults and seems to show tremendous variation.

Hale (1962) noted that the snout of the South Australian *Berardius* was relatively longer and that the lower jaw projected for a lesser distance as compared with these features in the female specimens of *Berardius bairdi* from Japan (Omura et al 1955). The proportions of the projection of lower jaw beyond the snout are 0.5% and 0.8% of the body length for the South African specimen and South Australian specimen respectively. These proportions fall within the range 0.3% and 1.0% given by Pike (1953) for two specimens of *B. bairdi* from British Colombia. So the possibility of this proportion as a distinguishing feature falls away.

TABLE 2

PROPOSED BODY PROPORTIONS AS DISTINGUISHING FEATURES
FOR *BERARDIUS* Spp.

	<i>B. bairdi</i>			<i>B. arnouxii</i>		
	British Colombia	St. George Island	St. George Island	New Zea- land	South Aus- tralia	South Africa
	(Pike)	(True)	(True)	(Hector)	(Hale)	
Sex and maturity	adult male	adult male	juvenile male	male	adult female	adult male
Total length	33'33"	40'2"	25'5"	27'6"	29'	30'6"
	%	%	%	%	%	%
Length pectoral flipper	13.0	12.4	13.4	9.4	8.9	7.9
Span of flukes ...	28.6	25.3	24.6	19.1	25.3	27.86
Hight dorsal fin .	2.3	2.5	2.4	3.0	1.7	1.6

From Table 2 it can be seen that the only external feature on which one could possibly separate the two species of *Berardius* (bar their relative size) is the pectoral flipper which appears to be longer in *B. bairdi* than in *B. arnouxii*. Yet Hale (1962) states the flippers of the South Australian specimen are fully as long and as wide as those of female *B. bairdi* recorded from Japan by Omura et al (1955) though he does not quote the measurements.

We may assume then that on external features alone, there is little ground for the separation of the two forms of *Berardius* as full species.

THE SKULL

The Skull and mandible were buried in dry sand high up on the shore and 9 months later were recovered for the museum. By this time meat and blubber had rotted away leaving the bones clear but unfortunately curio-hunters had made off

with teeth from the left mandible.

The skull of *Berardius* differs from those of the other members of the Ziphiidae in that the premaxillae are proximally symmetrical and do not form a canopy over the external nares as in *Mesoplodon* and *Hyperoodon*. The vertex of the skull is moderately elevated and is formed not so much by the premaxillae as by the nasals which are substantial in this genus. Further, proximal ends of the

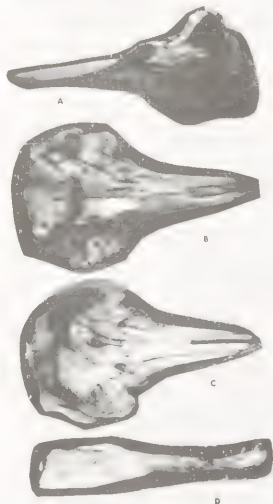


Plate 1

Skull of *Berardius arnouxii*

A. Lateral view, B. Ventral view, C. Dorsal view
and D. Lateral view of lower left mandible with
laterally compressed teeth.

premaxillae are not rugose or pitted as in *Hyperoodon*. In these and other features the skull of the South African specimen corresponds closely with descriptions (Flower 1874) of the skull of *Berardius arnouxii* with the exception that the mesethmoid is ossified for almost half the length of the rostrum while the description of the type reveals that the mesethmoid is only partially ossified. In this respect the South African specimen resembles the South Australian *Berardius arnouxii* and Hale (1962) states that the increase in ossification is probably due to the advanced age of the animal. (See Plate 1).

Once the flesh had rotted away from the mandible two teeth were revealed on either side of the mandibular symphysis. The teeth which are directed forward are conical and laterally compressed. The anterior being twice as large as the posterior. Both teeth are similar in structure; (See Plates 1 & 2) a small cone of dentine surrounded by a mass of cement which is almost completely covered by the alveolus of the bone and in the smaller posterior tooth by bone and gum. In accordance with Flower's (1874) description the pulp cavity is completely closed and the base rugose. Embedded in the alveolus of the anterior right-hand tooth were nodules of cement that had become separated from the tooth. Table 3 shows measurements of the skull of the South African specimen.

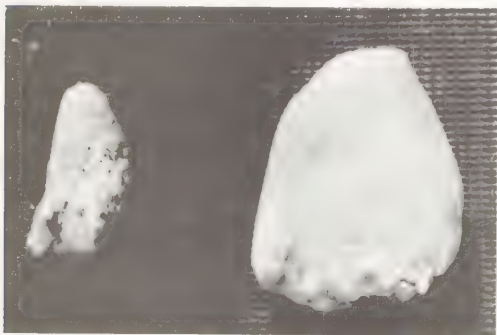


Plate 2

Laterally compressed teeth from lower jaw of *Berardius arnouxii*.

TABLE 3

MEASUREMENTS OF THE SKULL OF *BERADIUS ARNOUXI* FROM
SOUTH AFRICA P.E.M. 1496/67

Total length (Condylar-basal)	1262 mm
Vertex to inferior border of pterygoids	521 mm
Breadth across middle of orbits	615 mm
Breadth across posterior orbital processes	700 mm
Breadth across zygomatic processes	704 mm
Length of rostrum (tip to perpendicular line joining the base of the maxillary notches)	815 mm
Breadth of rostrum at base (measurement across the line joining the bases of the maxillary notches)	429 mm
Depth rostrum at middle	125 mm
Breadth rostrum at middle	202 mm
Length premaxillae	1075 mm
Breadth premaxillae at middle	111 mm
Greatest breadth premaxillae in front of nares	217 mm
behind nares	211 mm
Distance from anterior end of premaxillae to level of posterior border of pterygoids	1027 mm
Tip of rostrum to anterior border of vomer	674 mm
Length of vomer	205 mm
Length nasals	111 mm
Greatest breadth nasals	125 mm
Breadth of anterior nares	861 mm
Length nares (greatest median)	128 mm
Breadth across occipital condyles	1982 mm
Breadth across foramen magnum	805 mm
Breadth right condyl	71 mm
height right condyl	151 mm
Length of temporal fossa	274 mm
Depth temporal fossa	110 mm
Length mandible	1170 mm
Symphysial length	243 mm
Tip of mandible to centre of first tooth	47 mm
Tip of jaw to centre of second tooth	128 mm
Height coronoid	215 mm
Least depth of mandible behind first tooth	102 mm

The question arises whether there are cranial characters which could be used to distinguish *B. arnouxi* from *B. bairdii*. A character used by True (1910) to distinguish between the two species is the relative size of the head which is

supposed to approximate $\frac{1}{4}$ of the total length in *B. bairdii* and $\frac{1}{4}$ of the total length in *B. arnouxii*. In both the South African specimen and the South Australian specimen this fraction approximates the range for *B. bairdii* more than *B. arnouxii* and Pike (1953) has shown that the fraction is variable for *B. bairdii* so that this character would be unreliable in the determination of species.

Table 4 shows a comparison of skull measurements of 4 specimens of *Berardius arnouxii* (A1 - A4) with 4 specimens of *Berardius bairdii* (B1 - B4) expressed as the percentage of the greatest breadth across the post orbital processes this being a more durable dimension as compared with condylobasal length as the rostrum can be broken off or altered by beach wear.

EXAMPLE SPECIMENS USED IN TABLE 4

- A 1. Genotype, *Berardius arnouxii* (Duvernoy 1851).
- A 2. 32' *Berardius arnouxii* (Flower 1874)
- A 3. 29' female from South Australia, (Hale 1962) (*B. arnouxii*)
- A 4. 30' 6" male from South Africa 1963 (*B. arnouxii*)
- B 1. 29' immature female from Vancouver Island, British Colombia, (Pike 1953) (*Berardius bairdii*)
- B 2. *Berardius bairdii* male from Vancouver Island 33' Pike 1953
- B 3. *Berardius bairdii* 36' female from Japan (Omura et al 1955)
- B 4. *Berardius bairdii* 34' adult (probably female) from Washington (Slipp & Wilke 1955).

Table 4 proves nothing conclusive about the comparative dimensions of the skulls of the two species of *Berardius* for in all the ranges are similar and many overlap and there seems to be nothing in this series of measurements one can point to as a distinguishing feature between the two species.

True (1910) lists characters of the bones of the skull *in situ* which differ in the two species. Firstly he maintains that the rostrum is less massive at its base in *B. bairdii* than in *B. arnouxii* but other authors have pointed out that this character varies considerably from specimen to specimen and should not be taken into account. Table 4 also shows that the proportion, breadth or rostrum at base has the same range in *arnouxii* as in *bairdii*.

In comparing the skull of the South African specimen with photographs of skulls of *B. bairdii* supplied by True (1910), the differing characters listed by True are not apparent and the skulls are similar, but one must bear in mind that photographs are compared and not a specimen. True has stated that in *B. arnouxii* the nasal bones have lateral extensions whereas in *B. bairdii* the nasal bones have straight sides. In this respect the skull of the South African specimen does conform with the pattern of nasal bones for *arnouxii*.

CONCLUSION

With the study of more and more specimens of the genus *Berardius* it

TABLE 4

	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4
Total (condylobasal) length	186.1	200	180.0	180.3	203.8	187	196.8	181.8
Height from vertex to inferior border of pterygoids	66.0	77.7	92.5	74.4	79.7	73.9	79.1	73.6
Breadth across postorbital processes	100	100	100	100	100	100	100	100
Length of rostrum	119.5	134.0	109.2	115	132.0	117	127.6	116.7
Breadth of rostrum at base	55.3	58.2	65	61	60.2	58.1	60.5	56.3
Breadth of rostrum at middle	20	22.1	24	28	29.4	27.0	27.8	26.0
Length of premaxilla	-	-	155.0	153.5	180.9	158.4	191.1	162.6
Breadth of premaxilla at middle of length	12	13.3	17.4	15.9	20.9	17.1	15.7	15.7
Greatest breadth of premaxillae in front of nares	28	30.3	31.1	31	36.3	30.9	31.9	31.1
Greatest width of premaxillae behind nares	32	-	28.5	30.2	30.8	26.5	26.6	27.2
Distance from anterior end of premaxillae to level of posterior border of pterygoids	144.4	160.0	142.1	146.7	131.3	148.8	162.0	141.8
Length of nares (greatest median)	-	-	17.1	17.8	16.7	-	19.5	17.1
Breadth of nares (greatest)	13.6	10.78	14.0	12.3	19.6	12.7	15.9	16.6
Breadth across occipital condyles	28.4	27.84	31.4	28.31	32.8	31.9	33.0	27.9
Breadth condyle	-	-	13.5	10.1	15.2	14.9	15.1	13.9
Height condyle	-	-	22.0	21.5	26.3	23.4	22.6	21.6
Length of mandible (right)	165.2	181.5	165.0	167.1	180.6	173.2	180.1	-
Height at coronoid	29.7	30.8	32.8	30.7	32.2	31.3	32.4	28.2

becomes more and more apparent that the two species recognised, *B. arnoux* and *B. bairdi* are indistinguishable and one doubts the validity of *bairdi* as a species. There is a great distance between their distribution areas and it appears that in Northern seas the adult reaches a greater length. Such a character is indicative of a sub-specific relationship rather than specific.

AUTHORS' NOTE

The type *Berardius arnuxii* founded by Duvernoy in 1851 was named after Captain Bérard who attended the capture and M. Arnoux who supplied a brief description of this beaked whale. Later authors have referred to the animal as *B. arnouxii* (Flower 1874) *B. arnouxii* (Marelli 1920) *B. arnuxii* (True 1910) and *B. arnuxi* (Hale 1962). The present authors have chosen to adopt Professor Flower's spelling "Arnouxii" as being closest to the name from which it was derived.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. D. Taylor of Jeffery's Bay for reporting the stranding of the "Porpoise whale" and to express their gratitude to Mr. J. M. Spence of the Port Elizabeth Snake Park for help with photography.

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The Southern Bottle-nose
Whale *Hyperoodon planifrons*
from Humewood,
Port Elizabeth

ABSTRACT

The stranding of an adult male Beaked Whale *Hyperoodon planifrons* at Port Elizabeth is recorded. The distribution of this whale and its relationship to *Hyperoodon rostratus*, the Northern form, are discussed briefly.

INTRODUCTION

On the morning of January 18th, 1964, a specimen of the Southern Bottle-nose Whale *Hyperoodon planifrons* was washed up near the old slipway at Humewood, Port Elizabeth and was stranded at low tide. Members of the Museum staff were able to take measurements and photographs and secure the skull and mandible for the Museum before municipal officials disposed of the carcass. This is the first definite record of this species from South African coastal waters.

EXTERNAL FEATURES (see figure 1.)

The animal was an adult male beaked whale measuring 20 feet in length and weighing approximately 5 tons. In colour it was cloud grey but paler along flanks and belly and on the underside of the pectoral flippers. The head bore a prominent rounded forehead and well defined beak. In length the beak was shorter than that of *Berardius arnouxii*, another so-called Bottle-nose Beaked whale, and the lower jaw did not project beyond the snout. Even after careful examination no teeth



Figure 1

Scale outline of *Hyperoodon planifrons* to show form and external features



Plate 1

Skull of *Hyperoodon planifrons*

A. Dorsal aspect, B. Ventral aspect, C. Lateral aspect and D. Lateral view of lower right mandible (reconstructed) with tooth.

TIETZ - THE SOUTHERN BOTTLE-NOSE WHALE

were detected in the jaws. The blow-hole showed no curvature and took the form of a transverse slit lying just anterior to the vertical level of the eye. The V-shaped grooves beneath the chin, a distinctive character of the Ziphiidae are deep and well defined. The pectoral flippers are small as is the dorsal fin which is falcate and situated well behind the middle of the body. The flukes showed no trace of a median notch, another Ziphioid characteristic, in fact the rear edges of both flukes were concave and met medially to form a slight but distinct projection. The greatest girth of the animal lay just behind the insertion of the pectoral flipper.

The external measurements are recorded in table 1.

TABLE 1
BODY PROPORTIONS OF ADULT MALE HYPEROODON
PLANIFRONS FROM PORT ELIZABETH

	mm	%
Total length	6360	100
Length snout	215	3.4
Tip of jaw to vertical line of angle of mouth	507	7.9
Tip of beak to beginning of groove	457	7.2
Length throat groove	254	3.9
Height of forehead	304	4.8
Length blow-hole	178	2.7
Tip of beak to vertical level of eye	740	11.6
Tip of beak to axilla	1470	23.0
Length flipper, axilla to tip	686	10.8
Greatest breadth flipper	228	3.5
Tip beak to anterior base of fin	4100	64.5
Extent of base of dorsal fin	420	6.6
Height dorsal fin	290	4.6
Span of flukes (tip to tip)	1640	25.78

In external appearance *Hyperoodon planifrons* resembles the northern form *H. rostratus* and also the Beaked whale *Berardius arouxii* but differs from the latter in that the lower jaw does not project beyond the snout nor does it bear the two pairs laterally compressed teeth at its tip characteristic of *Berardius*.

For distinguishing between the species *H. planifrons* and *H. rostratus* one must turn to the features of the skull.

THE SKULL.

The original description of *Hyperoodon planifrons* (Flower 1882) was based on a mutilated skull found on Lewis Island, North-west Australia. In spite of its imperfect condition Flower was able to assign the specimen to the Genus *Hyperoodon* Lacépède and, at the same time pointed out characters distinctive of a new species; *Hyperoodon planifrons*. Among these of particular importance is

the formation of the maxillary bones, a feature from which the animal derives its name. In *H. planifrons* the crests formed by the maxillae have a broad base and are low and rounded. Posteriorly they pass over the temporal fossae to form a continuous side wall to the depression housing the nares, air sacs and musculature of the blow-hole. (See plate 1A). In *H. rostratus* the maxillary crests are more elevated and posteriorly they drop sharply so that there is a deep depression of the maxillary bone between the crests and the Vertex of the skull formed by the premaxillae and nasals. Further, the premaxillae and nasals of *H. planifrons* are more greatly developed and over hang the narial aperture quite considerably (Plate 1C).

The skull of the South African specimen is typical of that of *H. planifrons*. It is perhaps smaller in size than that of the type and in general differs in no very significant detail from the description of the type (Flower 1882) or from Fraser's (1947) description of a female specimen of *H. planifrons* from South Georgia.

Table 2 records the dimensions of the South African skull together with their percentage of the total (condylo-basal) length as well as these figures for the Discovery specimen (Fraser 1947), Type Specimen (Flower 1882) South Australian specimen (Hale 1931) and a specimen of *H. rostratus* for comparison.

From table 2 it can be seen that posteriorly the elevation of the supra-occipital is very much lower in the South African specimen than that in the other specimens of *H. planifrons* cited and is comparable with that of *H. rostratus*. The South African whale may be considered a fairly young specimen - the forehead is prominent but does not bulge as it is reputed to do in old males (Boschma 1951), further the teeth had not yet erupted. Possibly the development of the occipital elevation is a feature associated with the increase in the size of the melon or forehead with age.

In other respects the skull of the South African specimen is similar to those of the other specimens of *H. planifrons* tabled and the main differences between the skulls of the two species, *H. planifrons* and *H. rostratus*, are obvious from a comparison of the proportions. The maxillary crests are lower and wider at the base in *H. planifrons* while the skull is very much higher in this species due to the greater development of premaxillae and nasals at the vertex.

Turning from a comparison of the two species of *Hyperoodon* we come to a comparison of the three species of *H. planifrons* to find that the South African specimen resembles the female Discovery specimen (Fraser 1947) more closely than Hale's (1931) South Australian male. However, like the South Australian male, the South African male shows slightly broader and higher maxillary crests than in the female. This aspect of sexual dimorphism is considerable in the northern form *H. rostratus* but in this case is not apparent due to youth of male.

MANDIBLE AND TEETH

It is regrettable that the mandibles of the Bottle-nose whale were badly damaged and only fragments of both jaws and one tooth have been preserved. A reconstruction of the right mandible with the tooth has been attempted (Plate 1D)

TIETZ - THE SOUTHERN BOTTLE-NOSE WHALE

 TABLE 2
 SKULL MEASUREMENTS OF HYPEROODON PLANIFRONS AND HYPEROODON ROSTRATUS

	South African		South Australian		Discovery		Type		Hyperoodon	
	male		female		female		Specimen		rostratus	
	mm	%	mm	%	mm	%	mm	%	mm	%
Total length	1210	100	1391	100	1193	100	-	-	1333	100
Height of supra-occipital from upper margin of foramen magnum to top of occipital crest	249	20.6	410	29.5	348	29.1	375	-	295	22.1
Width of supra-occipital at narrowest part between hinder margins of temporal fossae	355	29.3	485	34.9	374	31.3	375	-	413	31.0
Width of foramen magnum	62	5.1	60	4.3	60	5.0	68	-	78	5.9
Height of skull to vertex	535	44.2	666	47.9	525	44.0	-	-	505	37.9
Greatest width of skull	636	52.6	-	-	601	50.4	-	-	665	49.9
Least width between orbital processes	470	38.8	-	-	593	49.7	-	-	631	47.3
Width of rostrum between antorbital notches	399	32.9	500	35.9	386	32.3	432	-	379	28.4
Length of rostrum (to antorbital notches)	726	59.9	857	61.6	688	57.7	-	-	823	61.8
Width of base of maxillary crest opposite antorbital notch	158	13.1	200-204	14.4-14.7	141	11.8	160	-	119	8.9
Greatest height of crest of maxilla	116	9.5	-	-	101	8.3	98	-	234	17.5
Height from bottom of nasal cavity to occipital crest	278	22.9	-	-	283	23.7	260	-	205	15.4
Greatest length of pterygoids	422	34.9	-	-	370	31.0	-	-	393	29.5
Tip of rostrum to posterior free border of pterygoids	933	77.1	1141-1150	82.0-82.7	948	79.4	-	-	1065	79.9
Tip of rostrum to anterior end of nasals	948	78.3	1065	76.6	863	73.2	-	-	1090	82.1
Breadth of rostrum in front of maxillary crests	169	13.9	210	15.1	170	14.6	190	-	161	12.1
Width of occipital condyles	211	17.4	237	17.0	209	17.5	212	-	263	19.7
Height	143	11.8	174	12.5	149	12.5	138	-	-	-

but measurements of this cannot be taken as finite except for Height of coronoid which is 174 mm.

In the fresh specimen the teeth were completely concealed by the gums but the tooth that has been recovered is conical measuring 51 mm in length with an unworn crown of dentine about 6 mm high at its apex and in every way resembles the teeth of the female. *H. planifrons* described by Fraser (1947).

In the Ziphiidae the teeth of the males are usually more massive than those of the females and the species of *Hyperoodon* usually conforms in this respect. Hale (1931) gives measurements of the teeth from a male *H. planifrons* which show that they are of the same length as those from the "Discovery female" and South African male and have a diameter twice as great. Furthermore the roots of the



Plate 2
Tooth from lower jaw of *Hyperoodon planifrons*

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teeth from Hale's specimen are closed, considered to be sign of age while the roots of both our specimen and the Discovery female are open. Thus the conical tooth pictured in plate 2 from the Bottle-nose whale washed up at Humewood is probably yet another indication of its youth.

DISTRIBUTION

Hyperoodon planifrons in contrast to *H. rostratus* which has a northern distribution, has been recorded from North-west Australia (Flower 1882) East Coast of South America (Moreno 1835), South Australia (Hale 1931), Queensland, Australia (Longman 1926 quote McCann 1962), South Georgia (Fraser 1947), and New Zealand (McCann 1961).

A beaked whale stranded at Mossel Bay in April, 1934 is thought to be a specimen of *H. planifrons* (Personal communication with Mr. P. Best, Hon. Curator of Marine Mammals at the South African Museum), but this is not certain. The stranding of *H. planifrons* at Humewood proves conclusively that this species does occur in South African waters and in no way alters McCann's (1962) conclusion that *H. planifrons* is restricted to the Southern hemisphere south of 20° latitude. In fact its presence in our waters provides a link between the two widely separated areas from which *H. planifrons* has been recorded.

ACKNOWLEDGEMENTS

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The range of the Booted Eagle,
Aquila pennata (Gmelin),
in Southern Africa with a
note on field identification

INTRODUCTION

Clancey (1964) gives the northern breeding range of this small, migratory eagle as "Iberian Peninsula, southern France and North Africa, eastwards through southern Russia to southern Transbaikalia, in the east, south to northern India (Punjab), wintering in Africa, Arabia and India."

Winterbottom (1935) records the southern limit of the range in Africa as the South West Cape on the strength of two mounts collected at Wynberg and a skin from Robertson. An analysis of records some ten years after Winterbottom's note shows a better but still incomplete picture of the distribution of *Aquila pennata* in Southern Africa.

RECORDED LOCALITIES IN SOUTHERN AFRICA

The following labelled specimens exist in museums of Southern Africa: Selukwe, October 1952, and Bulawayo, October 1907, (National Museum, Bulawayo); "Rhodesia," September 1903, Vryburg, December 1931, Matatiele, November 1912, Umtamvuma River, February 1909, Krugersdorp, December 1914, and three from Pretoria, November 1915, December 1964 and February 1912, (Transvaal Museum); Lourenco Marques, April 1957, (Museum Dr. Alvaro de Castro); one mount from Durban, April 1913, (Durban Museum); Griquatown, September 1961, (East London Museum); Kei Road, January 1924, two from King William's Town, December 1931 and February 1931, and "Eastern Cape Province", November 1924, (The Kaffrarian Museum); Addo, January 1961, Bellevue, November 1916, Bellevue and Kirkwood, no dates (Port Elizabeth Museum); Golden Valley, October 1927, (Albany Museum); Robertson, October 1910, (South African Museum). The Transvaal Museum skin labelled "Rhodesia" could well be the specimen mentioned by Priest (1933). McLachlan and Liversidge (1957) mention "two old records from Cape Town." These are referable to the Wynberg mounts recorded by Winterbottom. Both of the Wynberg mounts and a specimen from Durban recorded by Clancey (1964) now appear to be unavailable. An unlabelled skin in the Albany Museum is very likely to be the specimen from Aliwal North recorded by Hewitt (1931).

Literature reveals the following additional localities: Forests of Outeniqua-land, Clanwilliam and Nel's Poort (Layard, 1867), Ondongo, November 1866 (Andersson and Gurney, 1872), Saldanha Bay, breeding on the Berg River in September, Grahamstown, Chibisa (exact position in the Zambezi Valley unknown), breeding at Swellendam, Newcastle, November, (Layard and Sharpe, 1884), Rustenburg, February 1884 (Ayres, 1886), Aliwal North (Hewitt, 1931), Rondebosch, February 1828, (Roberts, 1936), Westminster, November 1953, (Maclean, 1957), Alexandria, Port Elizabeth and Uitenhage (Paterson, 1958), Punda Milia, December 1958, (Pienaar and Prozesky, 1961), Kalahari Gemsbok Park, January 1961, (Prozesky and Haagner, 1962), Estcourt district, 1946, (Clancey, 1964) and Lombard Nature Reserve, Bloemhof (Skead, 1965). Smithers (1964) does not include the species in his check list, though Clancey (1965) records occurrence in Bechuanaland based on a visual record (not his own) from Tuli Block.

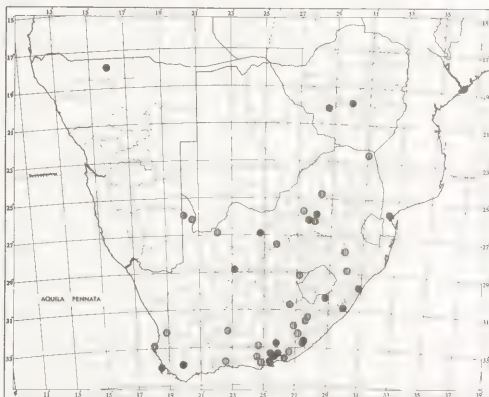


Figure 1

Recorded localities of the Booted Eagle, *Aquila pennata*, in Southern Africa. Black dots refer to specimens at present in museums of Southern Africa. Lined dots refer to visual and literature records.

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M. Courtenay-Latimer (*in litt.*) has records from Queenstown, Cathcart, Cala and Elliot. R. Liversidge (*in litt.*) has visually recorded *pennata* from Addo, February 1961, near Steytlerville, September 1961, Zuurborg at Slagboom, October 1962, Nossop River, Kalahari Gemsbok Park and Van Zyl's Rus, February 1963. R. A. Black (*pers. comm.*) captured a light phase bird in October 1958 at Johannesburg which was released in January 1959 (photographed). J. Blignaut (*pers. comm.*) captured and released a dark phase bird on the 5th September 1960 at Jansenville. P. Venter banded a bird in the pale phase, on the 30th December 1963 at Nylstroom (S.A.O.S. Ringing Card). On the 30th November, 1964 a dark phase specimen was brought alive into the Port Elizabeth Museum from Hankey. It had become entangled in the netting wire of a tennis court in an attempt to capture poultry. The bird was weighed, measured, banded and released. (Weight: 26.75 ozs., wing: 370 m.m. tarsus: 65 m.m.). P. Steyn (*in litt.*) has a record of an injured pale phase specimen in the possession of C. Fisher, obtained near Bulawayo in February 1965. C. Haagner (*in litt.*) has observed approximately fifty specimens, seemingly on migration, at Punda Millia in April 1965.

Winterbottom (1955) and Mackworth-Praed and Grant (1962) were doubtful as to the validity of the Berg River and Swellendam breeding records of Layard and Sharpe (1884). The subsequent eighty years have produced no further evidence to indicate breeding in Southern Africa. McLachlan and Liversidge (1957) have rejected the suggestion altogether. It is, therefore, most likely that confusion has arisen from original misidentification. If this is the case then these two localities at least, must be rejected together with reference to the prior suggestion of breeding.

HABITAT

For the northern part of its range, Voous (1962) and Peterson, *et al* (1954) state forest preferences and a strong affinity to trees. Recorded localities in Southern Africa (Fig. 1) indicate a preference for open woodlands and grasslands with scattered trees. Liversidge (1962) refers to the importance of "life-form" rather than distinct vegetation types in an attempt to correlate the distribution of birds with vegetation. "For example, some predators obviously require perches which give a suitable vantage point in order to spot their quarry." Indeed, the recorded localities reveal absence from only the most desertic, treeless and karroid regions. This conclusion may, however, be deceptive in that lack of records from these areas could be a reflection of human population densities.

PERIOD OF VISITATION

A. pennata has a more extensive period of stay in Southern Africa than is recently quoted (Clancey, 1964, 1965: Smithers *et al.* 1957). The earliest arrival dates are four for September. The bulk of records lie between October and February while three (including one for fifty individuals) are for as late as April (Table 1.). Occurrence covering eight months of the year would appear to allow little time for migration and breeding in the Northern Hemisphere. It is almost

certain that arrival and departure dates must vary according to the prevailing climatic conditions of the year.

TABLE 1.

TABLE SHOWING THE KNOWN FREQUENCY IN THE MONTHS OF
OCCURRENCE OF THE BOOTED EAGLE, *AQUILA PENNATA*, IN
SOUTHERN AFRICA

July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
-	-	4	6	8	6	3	9	-	3	-	-

FIELD IDENTIFICATION

Meinertzhagen (1954) and McLachlan and Liversidge (1957) indicate that phase coloration differences in *pennata* are present in the young and are retained throughout life. Harrison (1964) attributes the dark phase to a melanistic condition. From Southern African specimen and literature sources, where given, twenty-eight records for the pale phase of the species were found. The dark phase, by far less frequent, is recorded on only seven instances. As a rough index from the figures given, the pale phase would seem to outnumber the dark phase by almost four to one.

In the field, the conspicuous small size of this eagle will usually distinguish it from most other birds of prey. Perched, the feathered legs will eliminate confusion with the buzzards, *Buteo* spp. A small, but distinct, crest is usually present. The pale phase of *pennata* is extremely difficult to separate from immature Ayre's Hawk-Eagle, *A. dubia*. *A. dubia* has a longer crest, but lacks a very pale wing bar formed by the median wing coverts in *pennata*. *A. pennata* does not have the broad terminal tail bar found in *dubia*. Both *pennata* and immature *dubia* have dark cheek and ear coverts. The dark phase could lead to some confusion with Wahlberg's Eagle, *A. wahlbergi*. However, *pennata* has a pale wing bar, dark cheek and ear coverts and pale thighs, lacking in *wahlbergi*.

In flight, the Booted Eagle is very much of a soaring bird with tendencies to be kite-like, both in size and in the attitude of bent wings. The long, but square-cut tail distinguishes this bird from *Milvus* spp. The underside of the pale phase in flight (Fig. 2A.) has white underwing coverts with a characteristic line of dark spots on the posterior margin. The secondaries are dark but the primaries with light bases and dark tips give a slight "window" effect. The figure in McLachlan and Liversidge (1957) omits this feature. Peterson et al. (1954) give a slightly better version of the character. The chest is streaked with brown in contrast to the pale abdominal region. *A. pennata* lacks the very broad terminal tail bar found in *dubia*. The underside of the dark phase in flight (Fig. 2B.) agrees with

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Figure 2.

Flight patterns of Booted Eagle, *Aquila pennata*.

A. Ventral aspect of pale phase, B. Ventral aspect of dark phase, C. Dorsal aspect of either phase.

the two aforementioned references except that the white "window" of the primaries is too extensive in McLachlan and Liversidge and too inconspicuous in Peterson, et al. The thighs are very light in contrast to the dark brown of the wings and body, a feature which can avoid confusion with *wahlbergi*. The dorsal aspect of both phases (Fig. 2C.) is similar. The most pronounced features here being the pale median upper wing covert bands and the whitish upper tail covert bar. The tail except for the unmarked outer feathers, shows feint barring viewed from above or below.

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SUMMARY

As many literature and specimen localities as could be found for the Booted Eagle, *Aquila pennata*, in Southern Africa are listed and mapped.

Two old breeding records and their localities in Southern Africa are rejected on the grounds of original misidentification.

The range of the Booted Eagle in Southern Africa is widespread except for possibly desertic, treeless and karroid areas.

The known months of occurrence of the species in Southern Africa are from September to April.

The dark phase appears to be outnumbered by the pale phase at a ratio of four to one.

Some features to assist field identification are given.

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A Taxonomic Study of the
Boubou Shrike in Southern
Africa

Much confusion currently prevails concerning the taxonomic groupings best employed in describing the variation exhibited by the various forms of the highly polytypic Boubou Shrike, *Laniarius ferrugineus* (Gmelin) and *L. aethiopicus* (Gmelin) of the Ethiopian Region. The conservative approach, supported by the work of Roberts (1940), Selater (1930), and Rand (1960), favours recognising virtually all the forms as races of one species (*L. ferrugineus*), whereas Smithers et al. (1957), Benson & White (1957), Mackworth-Praed and Grant (1955), and Hall (1953), arrange this rather cumbersome unit of some 15 races in two or more discrete species.

Of all the authorities who have expressed an opinion on the subject under review, few appear to have actually undertaken a complete revision, utilising the accumulated skin material from the available museums, one notable exception being Mrs. B. P. Hall (loc. cit.), whose considered findings are based on the critical examination of a large panel of approximately 500 skins. This study led this worker to the conclusion that the group is best regarded as a superspecies, consisting of 4 species, viz., *L. ferrugineus*, *L. aethiopicus*, *L. bicolor* (Verreaux), and *L. turatii* (Verreaux).

Recognition of taxonomic distinction of a higher rank than the subspecies between *L. ferrugineus* and *L. aethiopicus* was not approved by the S.A. O.S. List Committee (1960), in respect of the South African forms. Traylor (1962) also accepted this decision, but then went on to show that the relationship between *L. ferrugineus* and *L. bicolor* was not so easily resolved, as in some areas of contact between these two forms the birds behaved as discrete species, segregated along ecological lines, whereas in other parts, intergradation as between two orthodox races of a single polytypic species is in evidence (cf. rejungent species).

In order to try and resolve these conflicting taxonomic views and bring about some measure of uniformity in the formal subspecific arrangements of the populations, a detailed study, involving approximately 700 specimens, was recently carried out at the East London Museum. Despite this large accumulation of material and much time spent on the study thereof, it was still not possible to deal with many of the geographical forms extralimital to Zoogeographical South

Africa. Attention was thus focussed on the more austral races with the idea of supplementing Mrs. Hall's study, which author had, by her own admission, insufficient material from these parts of Africa.

Up to the date of the preparation of this revision, a full appreciation of the extent and complexity of the variation this shrike displays has been denied systematists because of the inadequacy of the descriptive literature. This is especially applicable to material of the Southern African faunistic zone where classification and range definition are still largely guesswork, based as they are on the old, brief and somewhat conflicting descriptions of Roberts (1922, 1924 and 1940). A valuable contribution towards putting the races of Natal and Zululand on a modern footing has recently been made by Clancey (1964).

In this revision I have also endeavoured to throw more light on the vexed relationship between what has been known as the Tropical Boubou (the *aethiopicus* group) and the Southern Boubou (the *ferrugineus* group). Although Hall's 1953 account devotes space to such an appraisal, she had insufficient material of the two forms from along the entire length of the zone where the extremities of their ranges approach each other closely but still only just remain allopatric. Thus the matter was not fully resolved. Such a gap I hope to fill by the data now derived from additional material, especially from Mocambique.

With a good series of specimens from the Eastern Province and Natal littoral, which has only fairly recently been accumulated, and the combined resources of various institutions, it has been possible to view a full and truer picture of the total spectrum of variability than was hitherto possible. While this study has not shown the necessity of erecting new subspecies, some rearrangement of the ranges of existing taxa has become necessary, plus the recording of some local populations or micro-subspecies, which could with more collecting perhaps necessitate recognition as additional races.

Before considering the characters of individual taxa or even general variation trends, it is first necessary to review the group as a whole throughout its entire range. This, as indicated, covers most of the Ethiopian region, the birds of which are broadly divisible into three major groups, i.e. the *aethiopicus*, *bicolor* and *ferrugineus* complexes. (The position of *Laniarius turatii* is somewhat obscure, but for the purposes of this study need not be taken into account.)

GEOGRAPHICAL VARIATION

This shrike is extremely plastic and the picture presented by each racial taxon is not infrequently blurred by mutations and local variants, and almost every race contains some individuals that in some respects show characters diagnostic of other races. These resemblances may even be between races whose ranges are far removed from each other. Thus, a few Knysna females attributable to *L. ferrugineus ferrugineus* resemble on the underside their counterparts of the Pondoland coast attributable to *L.f. pondoensis*. Some females of *L.f. pondoensis*, on the other hand, resemble birds of Natal and the eastern Cape,

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while some inland Natal birds grouped as *L.f. natalensis* show affinities in certain characters to West Cape birds (*L.f. ferrugineus*) and *L.f. transvaalensis*. Moreover, some eastern lowveld individuals of the latter race are not unlike birds of the Natal coast, and so on.

However, it would be a definite mistake to lump all these forms together under one subspecies. In series, quite orthodox geographical variations and groupings are obvious. These groupings of populations into conventional subspecies are convenient in revealing the high plasticity of *L. ferrugineus*, resulting in local changes in mean rainfall, humidity and vegetational cover, bringing about readily demonstrable colour variation of a localised nature.

THE FERRUGINEUS GROUP

Variation within this assemblage of forms follows the normal pattern in birds, being darkly coloured in the west Cape and eastward to Humansdorp. This discrete form is recognised in this treatment as the nominate race *L. ferrugineus ferrugineus* and its range is restricted as detailed under taxonomic treatment and does not include Natal and the eastern Cape as in former descriptions.

Eastwards of the range of the nominate race a sharp transition towards a lightening of the dorsal colours in females and a reduction of ventral rufous in both sexes is demonstrable. This shift, however, does not occur so suddenly along the coast as it does in the drier interior, and populations as far east as East London tend to be mixed. These well marked lighter birds of the Eastern Cape are also visibly larger in size.

The birds of Griqualand East and most of Natal are again about the same size as the nominate race but in most other respects show closest affinity with east Cape birds with which population they are grouped as one race, viz. *L.f. natalensis* Roberts. The light feathers of the underside of the male reach their whitest in this form accompanied by a glistening surface lustre. This feature, however, is somewhat unstable and individual variation is evident.

In Pondoland, a darkly coloured group of populations occurs as an enclave, associated with the higher than average humidity and precipitation peculiar to those parts. To this race the name *L.f. pondoensis* Roberts has been applied.

In northern Zululand and southern Mocambique a well differentiated race, *L.f. tongensis* Roberts, occurs. Here the birds reveal the effect of Bergmann's Law in reflecting the outcome of inhabiting the humid Tropical littoral, being, on the average, as much as 10 mm. shorter in the wing than east Cape birds. Specimens are also decidedly paler in pigmentation especially the buffy caudad underparts of the male. Otherwise the birds are rather like diminutive specimens of *L.f. natalensis*.

From Panda, in the Inhambane district, northwards to the approaches of the Save River *L.f. tongensis* becomes darker with regard to the tone of the ventral buff, and some male specimens are as dark in this respect as many of the males of the more southern races.

The last race of this group, *L.f. transvaalensis* Roberts, is the only race with no contact with the littoral and is mainly a form inhabiting the more elevated parts of Natal, Swaziland and much of the Transvaal. It is characterised by a reduction in sexual dimorphism in that the breast of the male loses the white sheen giving way to a duller off-white tinged with buff, showing thus, approaches to the corresponding parts of the female. Dorsally the females revert to the dark hues of the nominate race.

Thus it will be seen that the nominotypical race is most closely allied to *L.f. transvaalensis* while the littoral populations of the eastern sector viz. *L.f. natalensis*, *L.f. pondoensis* and *L.f. tongensis* also form a rather compact group of closely related forms.

The males of the *ferrugineus* group give the impression of being shiny black dorsally, but if looked at under good lighting conditions, it is sometimes only the head and anterior portion of the mantle that are quite black, with the rest of the dorsal surface tinged to varying degrees with a dark greyish-olive. Often this suffusion does not cover more than the feathers of the rump. However the suffusion that invades the backs of the males of *L.f. tongensis* occurring from Panda northwards is much more conspicuous and of a different tone, being lighter and purer grey.

There is a slight tendency for the backs of males of the *ferrugineus* group to become glossier black from south to north. Actually the males with the purest, shiniest black backs are the representatives of *L.f. tongensis* that inhabit the southernmost parts of the subspecies' range.

THE AETHIOPICUS GROUP

In this group there is no indication of secondary sexual dimorphism and by comparison with the *ferrugineus* group there is little to describe in the nature of variation within the populations that occupy Rhodesia, Zambia, Malawi and the northern parts of Mocambique. Dorsally all the birds are a shiny blue-black, which is a very constant feature of the forms of the *aethiopicus* group.

The most evident variation is a slow somewhat irregular, cline in the intensity of the ventral coloration, from Zambia southwards over Rhodesia.

In comparing birds from Zambia, Malawi and the adjacent low-lying regions of Mocambique with those from most of Rhodesia, it will be noticed that the Rhodesian populations are distinctly darker ventrally. Birds of the northern parts of Zambia are virtually white below, with but little buff on the under tail-coverts, while the birds of the greater part of Rhodesia are mostly a medium shade of buff or peach from the throat to the under tail-coverts, the intensity of this colour increasing caudad. Immature specimens of the Rhodesian populations are much buffier than adults, though this is not nearly as noticeable in comparable specimens from Zambia.

Seeing there are no indications of the adult bird populations becoming darker or buffier towards the approaches of the Limpopo River Valley or south-

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eastern Rhodesia, the name *L. a. limpopoensis* will be used to include all the birds of Rhodesia except for parts of the Zambezi Valley and the remote eastern border. In these parts there are indications of the birds becoming whiter ventrally, especially in those occurring in the upper reaches of the Zambezi Valley west of Chirundu.

The range of *L. a. mossambicus* will therefore have to be shifted northwards in Rhodesia. Whether the birds of the central and southern reaches of Zambia are sufficiently distinct from *L. a. limpopoensis* to be included in the race *L. a. mossambicus* I leave future workers to decide. It will also have to be decided whether the race *L. a. mossambicus* as now defined is sufficiently distinct from *L. a. major* to stand as a discrete subspecies.

It has been found by Rosa Pinto (1958) that *L. f. limpopoensis* also reaches into Mocambique along the mountainous regions of the south-eastern borders of Rhodesia. Birds taken at Espungabera and examined personally, confirm this finding.

THE BICOLOR GROUP

The races of this group are as the name indicates, simply black above and white below, and the variation in and between the races is even less marked than in the *aethiopicus* group.

L. f. sticturus penetrates our faunistic zone along the Caprivi Strip and south to Maun in Ngamiland, keeping much to the swampy parts of this area.

TAXONOMIC INTERRELATIONSHIPS BETWEEN THE GROUPS

On *prima facie* grounds there are quite adequate reasons for recognising the three major groups discussed above as discrete species. However a careful study of the impinging or overlapping populations of these groups reveals some complex and interesting genetic relationships.

From this study it has become clear that the three groups cannot always be safely regarded as good species, nor are they merely all races of one species. There exists among these contiguous and overlapping populations every phase of evolutionary development from the species level, *via* rejuvent and semispecies, to straight forward intergradation typical of subspecies in initial or secondary contact.

The genetic relationship between the *L. bicolor* and *L. aethiopicus* forms is fortunately easier to understand because of an overlap in the ranges, than in the case of *L. aethiopicus* and *L. ferrugineus* forms, since the latter two closely approach one another, but do not overlap.

It has been very generally accepted that *L. bicolor sticturus* Finsch and Hartlaub is specifically discrete from *L. aethiopicus mossambicus*, there being no evidence of hybridisation where their distribution narrowly overlaps in the more southern part of their ranges along the Caprivi Strip. However, this settled opinion has recently been questioned by Traylor (*loc. cit.*), who found

evidence of intergradation between another two races of the same "species", i.e. *L.b. guttatus* and *L.a. major* in central and northern Angola, thus setting the stage for recognising these forms as components of one relict species, and for posing the recurring problem of expressing this adequately, from a nomenclature point of view.

No comparable evidence can be produced in support of the definite allocation of the *L. ferrugineus* and *L. aethiopicus* groups of forms since, to date, no locality has been found where their ranges overlap, although the possibility of this occurring is not unlikely.

After having reviewed the nature of the variation within the three major groups of Boubou Shrikes it would probably be expedient at this stage to focus attention on a comparison of these contiguous populations of the *L. aethiopicus* and *L. ferrugineus* groups as they occur in northern Transvaal, eastwards into Mocambique. For the sake of clarity the birds will be referred to by name in this part of the text, utilising the names employed by those who regard the two forms as discrete species. Thus we have *L. aethiopicus limpopoensis* and *L. a. mossambicus* as representatives of the Tropical Boubou occurring north of latitude 23°S in the northern Transvaal and Mocambique respectively and *L. ferrugineus transvaalensis* and *L.f. tongensis* representing the Southern Boubou and occurring south of the same line of latitude. Only males were used for measurement in order to eliminate the possibility of wrong sexing and immature males being confused with adult females. In *L. ferrugineus* adult males are quite unmistakable. Wing and tail measurements were used, as they appear to be the easiest and best means of assessing overall size.

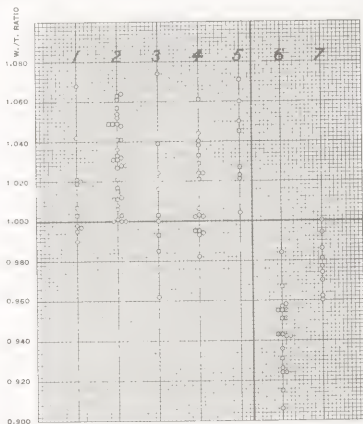
Although the two forms approach to within some 50-100 miles of each other in the northern Transvaal and the Sul do Save of Mocambique, their ranges have as yet not been found to overlap. The only geographical barriers separating their ranges are the Zoutpansberg mountains and the Save River respectively. These in themselves would, however, appear to be quite inadequate as physical barriers to restrict their ranges, and the answer most probably is to be found in habitat preferences, governed by differences of climate and vegetation. *L.a. limpopoensis* for example, appears to be at home in the Mopani veld (Acocks 1953) to the north of the Zoutpansberg range, while *L.f. transvaalensis* occupies tracts of various Bushveld types to the south of that range.

One of the characters worthy of elaboration in this comparison between the two populations is size. This is most striking in the northern Transvaal representatives of *aethiopicus* and *ferrugineus*, whereas in Mocambique colour differences most easily separate these two forms.

With regard to wing and tail dimensions we find that there is a remarkable increase in tail-length in *L.a. limpopoensis* when compared with *L.f. transvaalensis*. This by itself would not be so significant were it not for the fact that this sudden increase in tail-length is not accompanied by a corresponding increase in the wing measurement. This means that the proportion between wing and tail

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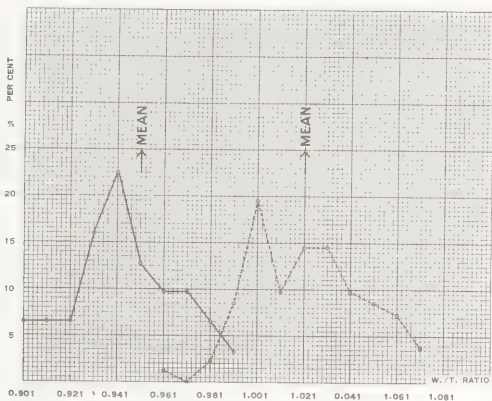
measurements of *L. aethiopicus limpopoensis* is quite different from that of *ferrugineus* or any of its races.



GRAPH A Graphical illustration of the distribution of the wing/tail ratios of individual birds about 1.000 (bold horizontal line) which is where wing and tail are of equal length. The *L. ferrugineus* races are figured to the left of the bold vertical line. Numbered columns represent the following subspecies:

1. *Laniarius ferrugineus ferrugineus*
2. " " *natalensis*
3. " " *pondoensis*
4. " " *transvaalensis*
5. " " *tongensis*
6. " *aethiopicus limpopoensis*
- + 7. " " *mossambicus* and others intergrading with *L. a. limpopoensis*

+ These specimens included for comparison



GRAPH B A frequency distribution showing the percentage of distribution of the two groups for the various wing/tail ratios as shown in graph A. Solid and broken lines represent the *L. aethiopicus* and *L. ferrugineus* groups respectively.

GRAPH B A frequency distribution showing the percentage of distribution of the two groups for the various wing/tail ratios as shown in graph A. Solid and broken lines represent the *L. aethiopicus* and *L. ferrugineus* groups respectively.

It was found that the difference between the means of the wing/tail ratios for the two groups (*ferrugineus* and *aethiopicus*) is very highly significant. Thus the difference was found to be 0.069 whereas the required difference for significance at the 1% level is only 0.017. In contrast to this the variation within the groups is very low giving a co-efficient of variation of only 2.1%.

It will be seen under taxonomic treatment that the average tail measurement of the various races of *L. ferrugineus* never exceeds the average wing measurement, whereas in populations of *L. a. limpopoensis* the average tail measurement is never less than the average wing measurement. In this connection it should be noted that there is no evidence of a cline in the wing/tail ratios which could

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connect populations of *L. ferrugineus* with those of *L. aethiopicus* in Southern Africa. In *L. a. limpopoensis* and *L. a. mossambicus* such a cline does appear to exist but this runs in an east/west direction, effected thus by the influence of the littoral and quite unrelated to the races of *L. ferrugineus* situated immediately to the south. On the other hand, the various races of *L. ferrugineus* have their wing/tail ratios fairly constant with no similar tendency for littoral populations to be markedly different from those further inland.

It is interesting to note that where two forms of Boubou Shrike do behave as discrete species (where their ranges overlap) there is a corresponding difference in physical dimensions. This is to be found among representatives of *L. a. mossambicus* and *L. bicolor sticturus* which share the same territory along the Caprivi Strip. *L. b. sticturus* here has very much the same wing/tail proportions as *L. ferrugineus*, being only larger in overall size.

As far as culmen height is concerned the two most northern races of *L. ferrugineus* have this measurement about 1 mm. less than most of the more southern races, the variation of averages among all races being from 8.5 - 10 mm. The beaks of *L. a. limpopoensis* and *L. a. mossambicus* are all consistently smaller, varying but little from 8.1 - 8.2 mm.

In Mocambique the more littoral populations of the representative races of these two groups, i.e. *L. a. mossambicus* to the north of the Save River and *L. f. tongensis* to the south, are smaller in overall size and the size differences are not nearly as marked. It is here that colour differences are more worthy of note and again it is obvious that there is evidence of substantially greater differences in plumage colour between contiguous and other populations of *L. aethiopicus* and *L. ferrugineus* than those that normally separate the races of each group.

In this connection it is important to keep in mind that in all the representative forms of *L. aethiopicus* there is a complete absence of sexual dimorphism as far as plumage coloration is concerned. Both sexes in adult dress are glossy blue-black dorsally and there are no exceptions. However, in the *ferrugineus* group variation of dorsal shades and sexual dimorphism is most marked. Only in *L. f. transvaalensis* is sexual dimorphism not particularly apparent; in no cases, however, are the female backs shiny blue-black as in *L. aethiopicus* but like its congeners tend to be variable in shade. The female back of *L. aethiopicus* shows no such variation.

It is also particularly noteworthy that in the adjacent populations in Mocambique sexual dimorphism in *L. f. tongensis* is as well developed as in any other race of *ferrugineus* and quite unlike the populations of *L. a. mossambicus* occurring to the north of the Save River where, as in *L. a. limpopoensis* and other allied races, sexual dimorphism is conspicuous by its absence.

It is felt that the above amply demonstrates that all the constituting elements of each of these two major groups are quite compact and closely knit. In other words each group contains a set of races, each with their own special spectrum or nature of variation.

Both major groups, therefore, can stand on their own with the taxonomical gap separating each one more sharply defined than that which serves to differentiate between the many races of each group.

While all this may favourably impress upon one the necessity for regarding the *aethiopicus* and *ferrugineus* groups as more than racially separable it still does not finally clinch matters when the next stage, specific differentiation, is considered: this in spite of the fact that the two groups have diverged ecologically and morphologically to such a degree that their recognition as species would certainly not lie beyond the bounds of credibility. However, since the two groups still appear to be allopatric, it would be safer at this stage of our knowledge to regard each one as a semi-species. This does not exclude the possibility of the groups being components of a superspecies, the uncertainty arising from the fact that there is no way of applying the objective test.

The intricate relationships between the *L. bicolor*, *aethiopicus* and *ferrugineus* groups are impossible to reflect in the present form of nomenclature. For the sake of convenience and also to prevent obscuring the above picture of these interrelationships, the specific names *aethiopicus*, *bicolor*, and *ferrugineus*, will be retained. Even if proved to be not entirely correct, it is felt that this arrangement certainly lies closer to their true taxonomic positions than grouping all the races of the Boubou Shrike, occurring over the entire Ethiopian region, under one species.

REMARKS

This shrike is a species of thick bushy tangles, in which it is adept at keeping concealed. The type of bush typical of the littoral regions is particularly to its liking and there its beautiful call notes are a feature of the terrain.

However, via watercourses etc., it has established itself in many inland bushy kloofs and open forests. Their inland movement in the Cape has, however, been halted by the barrenness of suitable cover of the Karroid tracts. Thus the Boubou Shrike would appear to be absent from most of the N.W. Cape, Orange Free State, S.W. Africa, Kalahari and the Transvaal Highveld.

The great diversity of colour pattern and shading would appear to be not only the result of a high degree of plasticity in the genetical constitution of the species and featuring thus a higher sensitivity to differing ecological conditions, but also to be fostered by the birds themselves being of more or less sedentary habits. Although this point cannot be proved, it seems a reasonable inference after a consideration of their habits and the many races and forms that have been evolved. An interesting observation in this connection, made by Mr. P. A. Clancey, is that the birds of the *aethiopicus* group occurring in the Limpopo river basin and northwards, are not always to be found in dense thickets and are less secretive. He also notes the possible connection between the typically shy habits and restriction to thick cover and consequent greater development of local colour and voice variation of the more austral races comprising the *ferrugineus* group

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as compared with the greater uniformity of *aethiopicus* populations.

Mention must be made of yet another factor which serves to make the orderly grouping of this shrike even more difficult. This is the unusually high proportion of individuals that bear signs of immaturity. Especially vexing are the females of the *ferrugineus* group, where from 40 to 80% (usually over 50%) of the individuals bear either the full complement of immature characters, or only one, or even more perplexing, only very faint indications of being in other than adult feather. From what has been observed, it appears that even some fully adult or reproductively mature females may still bear the characters of immaturity. Approximately 80% of the available sample of females of *L.f. pondoensis* should, from outward appearance, be classed as immature. Immature males (which resemble females in the *ferrugineus* group) are far fewer in number and present no problem because of the marked difference of adult males. It seems apparent, therefore, that females, at least of the *ferrugineus* group, retain the characters of immaturity for some lengthy and indefinite period. For this reason it was found quite impractical for purposes of measurement *etc.*, to weed out all the individuals that appear to be other than adult. Only birds with a clear, full complement of immature characters were eliminated. All the individuals attributable to *L.f. pondoensis* had to be used, however.

No immature males were used for measurements. Most obvious of the immature characters are the buff tipping to the wing-coverts, and the bill, especially the lower mandible, being horn-coloured and not black. Immatures may also have a distinct barring of breast feathers, while juveniles have, in addition, russet tipping to the feathers of the back.

Measurements of the wing were made by flattening the curve of the primaries along a ruler. Culmen height was measured vertically over the nostrils.

ACKNOWLEDGMENTS

For the loan of additional specimens I am indebted to the Directors of the following institutions:- Durban, Transvaal and South African Museums; also the National Museum of Southern Rhodesia and the Instituto de Investigacao Cientifica de Mocambique.

My thanks are also due to the Director of the East London Museum, Miss M. Courtenay-Latimer, for advice and encouragement, to Mr. P.A. Clancey, Director of the Durban Museum, for his quite invaluable assistance at all stages of the pursuit of this study and to Mr. D.W.W.Q. Smith, Statistician at the Dohne Research Institute, for his valuable contribution involving the statistical analysis and graphical representation of the wing/tail ratios.

SUMMARY

The historical background of earlier taxonomic treatments, geographical variation and interrelationships of major groupings and finally, the variation and

characters of each racial taxon, are discussed. As such it is the first complete revision of the Southern African material of the Boubou Shrike, **Laniarius ferrugineus** Gmelin.

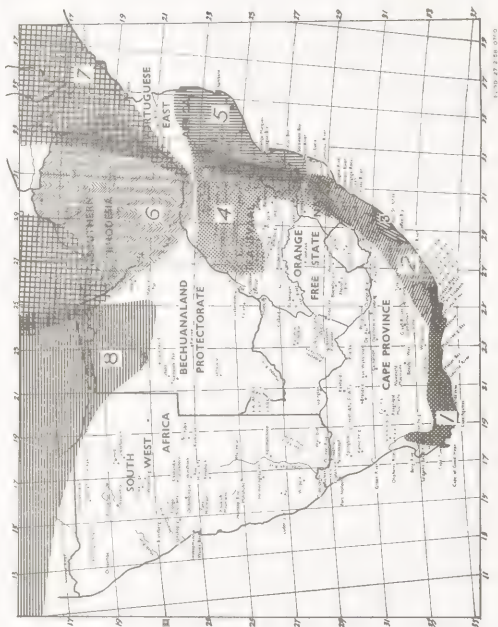
Much controversy surrounds the taxonomic arrangement of the forms of this shrike. This is thought to stem from the lack of adequate descriptive data, these being all the more vitally necessary in the case of this shrike as it is noted for being highly polytypic. Thus the major groups and subspecific taxa have been described in some detail, and various interesting and complex taxonomic relationships have emerged.

It is concluded that the **ferrugineus** and **aethiopicus** groups are semispecies but that the relationship between **bicolor** and **aethiopicus** assumes the nature of a rejunctive species.

Map showing the approximate ranges and zones of overlap of **Laniarius bicolor sticturus** Finsch & Hartlaub, and the races of **Laniarius ferrugineus** (Gmelin) and **Laniarius aethiopicus** (Gmelin), occurring within the Southern African faunistic Region.

1. **Laniarius ferrugineus ferrugineus** (Gmelin)
2. " " **natalensis** Roberts
3. " " **pondoensis** "
4. " " **transvaalensis** Roberts
5. " " **tongensis** "
6. " **aethiopicus** **limpopoensis** "
7. " " **mossambicus** (Reichenow)
8. " **bicolor sticturus** Finsch & Hartlaub

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TAXONOMIC TREATMENT
LANIARIUS FERRUGINEUS (GMELIN)
RACES OF THE FERRUGINEUS GROUP

1. **Laniarius ferrugineus ferrugineus** (Gmelin)

Lanius ferrugineus Gmelin, Syst. Nat. vol. 1, pt. 1, p. 306, 1788: Cape of Good Hope. Here formally restricted to the Cape Peninsula, Cape Province.

Diagnosis. Sexually dimorphic. **Male:** black to blue-black on upper-parts, with some specimens being glossier than others. Rump of ten tinged with greyish-olive, which sometimes extends up the back. On the underside, the anterior parts are mostly a dull, light creamy white, but certain specimens are a clearer white than others. The posterior portion, including under tail-coverts, thighs and flanks and most of the abdominal feathers, is washed a rich rufous, which colouring is also basal to much of the breast feathering, but lies concealed by the overlapping of the whitish terminal feather portions. However, a rufous feather showing up here and there over the breast is not unusual.

Female: Dark colours predominate, these being shades of blackish-grey, which are rather evenly distributed over the head, neck, ear-coverts, orbital feathers and back. Olive tones are not conspicuous and when present are surface tints showing on the rump, sometimes extending anteriorly over the back. This olive coloration resembles that occurring in **L. f. pondoensis**, and occasional specimens are in fact more profusely washed with olive than others, and thus show some approach to the race of the Pondoland littoral. Underside also a rich rufous, fading anteriorly over the breast to a lighter buff and still further to the throat which is pale buff. Not a few specimens have the breast feathers tipped with smokey grey. Immatures have these areas often more distinctly barred.

Both sexes have the major wing-coverts broadly white. A few of the tertials, usually two, also exhibit white as an edging to the outer web, and the white of the coverts and secondaries tends to meet to form a broad white wing-bar.

Measurements. Males: Wing 92.0 - 99.5 (97.9) 13 specimens, tail 92.3 - 100.0 (96.4) 14 specimens, culmen height 9.3 - 10.0 (9.6) mm. 14 specimens.

Females: Wing 90.5 - 99.0 (94.0) 11 specimens, tail 90.0 - 97.2 (93.2) 8 specimens, culmen height 8.8 - 9.4 (9.0) mm. 8 specimens.

Material. 31 specimens, South-Western Cape (10 males, 10 females), Little Karoo (3 males, 2 females), Southern Cape (3 males, 3 females).

Range. From the Clanwilliam district of the South-western Cape, south and south-east to include most of the Cape districts and the Peninsula. Eastwards the range includes about a 50 - 70 miles coastal strip of the southern Cape terminating, presumably, at the approaches to the Gamtoos River, in the Eastern Cape.

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Remarks. Intergrades with *L.f. natalensis* to the east of the Gamtoos River, mainly in a narrow coastal strip to about Alexandria and inland to about Grahamstown.

2. *Laniarius ferrugineus natalensis* Roberts

Laniarius ferrugineus natalensis Roberts, 1922. Ann. Transvaal Mus., 8(4):246. Weenen & Dargle districts in Natal uplands. Type from Weenen, Natal.

Diagnosis. Male: Similar to the nominate race on the upperside except that there is a tendency for Natal birds to become more blue-black and glossier. From *L.f. ferrugineus* differs below in that the white of the throat and breast extends further posteriorly, thus restricting the rufous suffusion of the belly. Rufous feathers also not reaching as far anteriorly over the flanks. Feathers of the breast, etc., a purer white, often with a glistening surface sheen. Rufous belly suffusion not quite as dark, especially in east Cape birds.

Female: Lighter and greyer than *L.f. ferrugineus* on the upperparts especially over the ear-coverts, which are often distinctly lighter grey than the rest of the dorsal surface. Feathers surrounding the orbit of the eye are often mottled with small off-white markings. This character is typically found well developed only in this race, *L.f. pondoensis* and *L.f. tongensis*. The upperside olive suffusion is better developed, more conspicuous and occurs more frequently. The tone is also rather different, being a lighter shade, with a more greenish-yellow tint, seen to better advantage when the specimen is tilted towards the light at a certain angle. On the under surface again differs from *L.f. ferrugineus* in that females are generally lighter throughout, eastern Cape birds more so than those of Natal. Throat whiter, sometimes showing up as a distinct whitish throat-patch with a fairly sharply defined lower edge. The breast is very pale in many specimens from the drier parts.

Both sexes of the east Cape populations are quite noticeably larger in size than the nominate race. This size difference is even more obvious if the more inland populations of the eastern cape are compared with *L.f. ferrugineus*.

Measurements. Males: Wing 94.0-103.0 (100.0) 37 specimens, tail 91.6-103.0 (97.3) 33 specimens, culmen height 8.8-10.4 (9.5) mm. 34 specimens.

Females: Wing 90.5-102.0 (96.2) 28 specimens, tail 90.9-99.4 (94.4) 24 specimens, culmen height 8.7-9.9 (9.3) mm. 26 specimens.

Material. 131 specimens. Eastern Cape 107; Natal 24.

Range. From the more inland parts of eastern Cape east of the Gamtoos River passing eastwards through Albany north of Grahamstown, and from then on broadening to include the coastal strip, except the moist Pondoland

littoral. The range continues through Griqualand East and includes most of Natal.

Remarks. Although this race consists of rather divergent elements, no useful purpose would be served by subdividing it. The eastern Cape populations, although differing somewhat from Natal birds, are strangely enough, more different from *L. f. ferrugineus* (although closer in range) than Natal birds are from the nominate race. However, the kinship between east Cape and Natal birds is clearly evident.

L. f. natalensis intergrades with no less than four other races, i.e. in the south-east with *L. f. ferrugineus*, further north-east with *L. f. pondoensis*, and in the extreme north of its range with both *L. f. tongensis* and *L. f. transvaalensis*, the latter from further inland.

The populations of *L. f. natalensis* occurring in the upper and northern parts of the province of Natal, i.e. Weenen, and White Umfolozi River, and even in one specimen from the Ngoye Forest, near Eshowe, in Zululand, clearly begin to show the characters of *L. f. transvaalensis*, although in size they are close to *L. f. natalensis*. It was from these unstable intergrading populations that Roberts described *L. f. natalensis*. Along the upper Pongola, in northern Zululand, the change-over is virtually complete where typical specimens of *L. f. transvaalensis* occur, accompanied by a rather sudden drop in size.

3. *Laniarius ferrugineus pondoensis* Roberts

Laniarius ferrugineus pondoensis Roberts. 1922. Ann. Transvaal Mus., 8(4):246. Port St. Johns, Pondoland.

Diagnosis. Males not markedly different from those of *L. f. natalensis*, but females most distinctive in that their backs show a climax of olive intrusion, the entire dorsal surface and sides of neck being a pure olive with a strong sepia tone. An occasional specimen reveals some greying about the mantle. About the ear-coverts and orbital feathers the resemblance to *L. f. natalensis* is close, except that the off-white mottling of the orbital feathers is more strongly developed.

Ventrally the females are very dark rufous, as in the nominate race. The sooty clouding of the breast feathers is also the most strongly developed in this race, imparting to the whole under-surface a heavily pigmented appearance. The males are not very distinctive in coloration, but the caudad ventral rufous is very dark.

The culmen is another feature which is best developed in this race with some specimens reaching 10.5 mm. in height at the nostrils. The overall size, however, is small averaging even rather less than *L. f. ferrugineus*.

Measurements. Males: Wing 93.0 - 100.5 (96.7) 9 specimens, tail 92.2 - 104.6 (95.7) 14 specimens, culmen height 9.5 - 10.4 (10.0) mm. 11 specimens.

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Females: Wing 89.5-98.5 (93.5) 12 specimens, tail 89.3-98.8 (94.1) 10 specimens, culmen height 9.3-10.5 (9.8) mm. 12 specimens.

Material. 30 specimens. All from the Pondoland coastal districts.

Range. The exact range of this race is still very obscure but it is fairly certain to be found in most parts of the Elliotdale, Ngqeleni, Port St. Johns, and Lusikisiki districts. It would seem not unlikely to penetrate the southern littoral of Natal, though not so listed by Clancey (*loc. cit.*).

Remarks. This unusual race with its limited range clearly shows the high plasticity of this species, where a small humid and moister than average strip of coast can elicit a response in the genotype to produce this distinct phenotype.

4. *Laniarius ferrugineus tongensis* Roberts

Laniarius ferrugineus tongensis Roberts. 1931. *Ann. Transvaal Mus.*, 14(3):240. Manaba, north-eastern Zululand.

Diagnosis. **Male:** Glossed, blue-black dorsally, especially marked in the males of northern Zululand and southern Mocambique. From about Panda northwards the extension anteriorly of an overlay of pure grey from the rump is evident. Ventrally, southern specimens, including the Type-specimen, have rufous over the belly toned down to a light buff. The type, in particular, is among the individuals with the lightest shade of ventral buff found in any specimens of the races of the *ferrugineus* group. Skins from Panda northwards are again much darker, with some possessing rufous tones, reminiscent of *L.f. natalensis*. Such northern examples of *L.f. tongensis* also tend to become pinker or slightly buffy over the white parts of the breast. Specimens to the north-west and west of the range become even more buff, showing the influence of the contiguous *L.f. transvaalensis*.

Female: Not unlike *L.f. natalensis* on the upperparts, but with a suppression of the olive shades, inclining to pure grey. Orbital feathers and ear-coverts similar to *L.f. natalensis*. On the underside again lighter than *L.f. natalensis*, but agreeing in all other respects.

Both sexes are considerably smaller than all the foregoing races, thus:-

Measurements. Males: Wing 88.0-96.5 (91.9) 14 specimens, tail 85.7-94.0 (89.1) 11 specimens, culmen height 7.7-9.2 (8.5) mm. 14 specimens.

Females: Wing 84.0-91.5 (87.5) 16 specimens, tail 83.4-94.4 (87.0) 13 specimens, culmen height 8.0-9.0 (8.4) mm. 13 specimens.

Material. 39 specimens. Northern Zululand 6, Swaziland 8, Mocambique 24, including specimens from Panda, Mabote, Funhaloura, Vilanculos etc., and Transvaal 1.

Range. Occupies the low lying coastal plain from the Makatini Flats of northern Zululand to the Save River, Mocambique.

Remarks. As in *L.f. natalensis*, this is another race showing some divergence in the populations occurring at opposite ends of its range, but

which at this stage does not appear to warrant sub-division of the present taxon. More collecting from the northern parts of the range may however necessitate a revision of such an opinion.

Intergradation with *L.f. transvaalensis* takes place along a north-south inclined line all along the western borders of Mocambique and eastern Swaziland. Many specimens from the lowlands of eastern Swaziland are typical *L.f. tongensis*. It appears as though *L.f. tongensis* also penetrates the lowveld of the Transvaal as a single male specimen from Newington closely resembles examples of the populations in the northern aspects of its range

5. *Laniarius ferrugineus transvaalensis* Roberts

Laniarius ferrugineus transvaalensis Roberts. 1922. *Ann. Transvaal Mus.*, 8(4):246. Swaziland, Barberton, Lydenburg... Rustenburg districts. Type from Leouwe Creek, Barberton.

Diagnosis. The most salient character in the male of this race is the almost uniform ventral surface suffused throughout with pinkish buff, not particoloured as in the more southern races, approaching the female in this respect. Chest and throat are, however, often paler than in the female.

The most striking feature in the female is the dark blackish-grey of the upperside, ear-coverts, and orbital feathers, which are similar to the nominate race, but in the population of the central regions of the Transvaal these parts are darker. In topotypes and other specimens from the lowveld the dorsal feathers are not so dark and the race is rather like *L.f. natalensis* in this respect.

Ventrally females are again not unlike those of the nominate race except for the ventral rufous being not as saturated, and the almost entire disappearance of any sooty tipping to the breast feathers.

Measurements. Males: Wing 89.5-99.0 (93.8) 24 specimens, tail 89.0-99.7 (93.0) 18 specimens, culmen height 8.0-9.1 (8.5) mm. 22 specimens.

Females: Wing 87.5-102.0 (93.8) 17 specimens, tail 85.9-102.5 (93.6) 15 specimens, culmen height 8.0-8.9 (8.4) mm. 15 specimens.

Material. 54 specimens. Northern Zululand 2, Swaziland 4, Transvaal 48.

Range. A race of the interior plateau of south-eastern Africa, occupying all the more elevated parts of northern Zululand (west of the Lebombos), Swaziland, Transvaal lowveld, middleveld and most of the bushveld of the west, north-west and northern Transvaal.

Remarks. A race of wide distribution and again composed of differing demic elements, with the darker birds occupying the central and more elevated parts of the Transvaal interior.

SOUTHERN RACES OF THE AETHIOPICUS GROUP

1. *Laniarius aethiopicus limpopoensis* Roberts

Laniarius ferrugineus limpopoensis Roberts. 1922. *Ann. Transvaal Mus.*,

8(4):246. Lilliput, Sand River, Zoutpansberg district, northern Transvaal.

Diagnosis. Complete absence of sexual dimorphism in external coloration. Glossy blue-black dorsally and typically buffy below, the shade of this colour increasing in intensity posteriorly. Some specimens are lighter ventrally, being tinged with peach or pink, while occasionally a very pale, almost white specimen is encountered. This race is more darkly coloured below than the one immediately to the north and east, i.e., *L.f. mossambicus*. Series from populations existing in close proximity to *L.a. mossambicus* are therefore lighter. This is evident in birds towards the eastern parts of Rhodesia and the Zambezi valley of Matabeleland. Immatures are a richer buff below than adults.

Measurements. **Males:** Wing 86.5-108.0 (98.8) 25 specimens, tail 89.3-113.1 (103.9) 22 specimens, culmen height 7.6-8.9 (8.2) mm. 19 specimens.

Females: Wing 89.0-101.5 (94.1) 21 specimens, tail 91.1-107.3 (99.4) 18 specimens, culmen height 7.0-8.4 (7.8) mm. 19 specimens.

Material. 90 specimens. 20 from the lowlands of the Limpopo and Sabi/Lundi River valleys, 8 from the eastern districts (including Rusape); 53 from the interior plateau and 9 from the northern parts of Rhodesia.

Range. The lowlands of the Limpopo River basin, from the northern Transvaal, extending northward into Rhodesia to the Zambezi River Valley where intergradation with *L.a. mossambicus* occurs. Possibly penetrates the southern and more central parts of Zambia. Also penetrates Mocambique to the east of Mount Selinda, in the Melssetter district of Rhodesia.

Remarks. This is rather an unstable race and difficult to define satisfactorily merely by degree of ventral buffiness, which, as indicated, is clinal and subject to quite a measure of individual variation. It is retained for the sake of convenience, and in part to account for the undoubted increased buffiness or darker peach of many of the birds of the greater part of Rhodesia, i.e. Matabeleland (except Zambezi valley), the midlands and Mashonaland. Intergradation with *L.a. mossambicus* takes place along the eastern districts and to a lesser extent along the Zambezi valley west of longitude 29°W where most of the birds are clearly attributable to *L.a. mossambicus*.

2. *Laniarius aethiopicus mossambicus* (Fischer & Reichenow)

Dryoscopus major mossambicus Fischer & Reichenow. 1880. Journ. f. Ornith. 28:141, Mocambique.

Diagnosis. Similar to the previous race, but clearer white below. Underparts typically pale pinky buff or peach with a slight darkening of this colour over the thighs and under-tail coverts. Birds become whiter below towards the north-west and east of the range. Malawi birds are especially white below, with only faint traces of buff about the abdominal surface.

Measurements. **Males:** Wing 88.5-100.5 (94.9) 15 specimens, tail

89.0-106.0 (98.7) 10 specimens, culmen height 7.7-8.3 (8.1) mm. 16 specimens.

Females: Wing 83.0-98.5 (91.0) 13 specimens, tail 86.7-105.4 (96.1) 11 specimens, culmen height 7.1-8.2 (7.6) mm. 12 specimens.

Material. Approximately 35 specimens. 20 from the Zambezi valley west of Chirundu, 5 from the eastern districts; 6 from Malawi and 2 from the south-eastern lowlands of Rhodesia. About 12 specimens also seen from Mocambique, north of the Save river.

Range. Most of the Zambezi River valley, Zambia and Mocambique (north of the Save River) and parts of the eastern districts of Rhodesia. Inter-grades with *L.f. major* in northern Zambia, the line of merger being taken as lat. 12°S; also with *L.f. sublacteus* (Cassin) about Dar-es-Salaam, Tanganyika.

Remarks. This race was originally described from Mocambique and when Roberts (1922) reviewed *L.a. mossambicus* he only had specimens from these parts, i.e. the lower Zambezi River and Beira. In the same publication he also introduced the race *L.a. limpopoensis* with specimens from the Limpopo Valley which were quite clearly darker ventrally than birds from the Mocambique littoral. The mistake made by subsequent workers was to overlook the very close affinity of birds from the bulk of Rhodesia (the plateau) with those classified as *L.a. limpopoensis* and to group the former with the ventrally much paler populations of the Mocambique littoral (north of the Save River) under *L. a. mossambicus*.

SOUTHERN RACE OF THE BICOLOR GROUP

1. *Laniarius bicolor sticturus* Finsch & Hartlaub

Laniarius sticturus Finsch & Hartlaub. 1879. *Vog. Ost. Afr.*, p. 342: Lake Ngami, Bechuanaland.

Diagnosis. Sexes alike, and similar dorsally to birds of the *aethiopicus* group. Ventrally it differs in being quite white. The feathers themselves are white throughout their length, whereas in the races of the *aethiopicus* and *ferrugineus* groups a basal buff to the breast feathers is apparent if the feathers are lifted.

Compared to *L.f. mossambicus* this race is conspicuously larger.

Measurements. **Males:** Wing 102.3-110.0 (107.4) 5 specimens, tail 100.0-109.0 (106.0) 5 specimens, culmen height 7.4-7.9 (7.6) mm. 5 specimens.

Females: Wing 102.5-108.0 (105.2) 2 specimens, tail 101.0-104.6 (102.8) 2 specimens, culmen height 7.7-7.9 (7.8) mm. 2 specimens.

Material. 8 specimens. All from a limited area in northern Bechuanaland and the Chobe River.

Range: Penetrating the South African subregion in riverine cover in Bechuanaland and on the Chobe River, narrowly overlapping *L.f.*

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mossambicus along the lower Chobe near its junction with the Zambezi. Extralimittally extends throughout southern Huila, from about the Caculovar River southwards (vide Traylor, *Check-list of Angolan Birds*, Q63, p.178); also to Barotseland (north to Kalabo), in south-western Zambia (vide Benson & White, *Check List Birds of N. Rhod.*, 1957, p.105).

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Notes on *Cordylus macropholis*
Boulenger

SUMMARY

The known range of *Cordylus macropholis* is extended 200 miles south by the discovery of the species at Lamberts Bay. The descriptions in the literature are reviewed and revised.

INTRODUCTION

During the Port Elizabeth Museum Collecting Expedition (1964) to Little and Great Namaqualand, four specimens of *Cordylus macropholis* were collected at Lamberts Bay. There were kept alive and exhibited in the Snake Park where one female subsequently gave birth to a single young on 17.5.65.

Cordylus macropholis has been described in the literature on the basis of nine specimens. The Type, S.A.M. No. 434 is still in the South African Museum but the collector, exact locality and date of collection are now known. In the Museum Catalogue, No. 434 is listed as *Pachydactylus maculatus*. How aquired; "no history", locality: "Namaqualand". In the left hand margin of the page, next to the number, is written in pencil "under this number is a Zonurus probably new", followed by an illegible squiggle and then "39a". Under remarks, in pencil is written "Type of *Zonurus macropholis* Boul." In his original description Boulenger (1910) changed the Type locality to "Little Namaqualand."

The date at the top of the page is 3.9.96; this is probably the date on which the specimen was catalogued but not when it was collected. It is therefore likely that it was collected some time before or during 1896 but was not described by Boulenger until 1910. There does not appear to be any *Pachydactylus maculatus* in the Museum numbered 434, nor is the species known from Namaqualand.

FitzSimons (1943) mentioned that there are specimens in the Natal, Kimberley and Transvaal Museum collections, while Loveridge mentions three in the Field Museum of Natural History. Five were found in the Kimberley Museum and one in the Transvaal Museum. No specimen can be traced in the Natal Museum (Pringle, personal communication) and the specimens in the Field

Museum of Natural History are presumably still there.

The authors were therefore able to examine twelve specimens: The Type, S.A.M. No. 434 from Namaqualand; T.M. No. 18,449 from Kleinsee, collected Feb. 1935; five in K.M. (not catalogued but numbered 1-5 for the purposes of this paper) also from Kleinsee, collected by F.C. Wecke and R. Orpen - dates unknown. The remaining five are the four live adults from Lamberts Bay, plus the young individual born on 17.5.65 (P.E.M. No. 1501/26).

Reviewing the literature: Boulenger (1910), Power (1933), FitzSimons (1943) and Loveridge (1936) and (1944) it appears that there is some confusion about the preocular scalation.

Boulenger (1910) in the original description mentions an "anterior loreal" but makes no mention of a preocular. Power (1933) describes a loreal and a postnasal but, as Loveridge (1944) rightly points out, Power's "loréal" is a preocular and his "postnasal" a loreal. FitzSimons (1943) states that there is only a loreal as shown in his figure 358, while Loveridge (1944) notes both a loreal and a preocular. The Type S.A.M. No. 434 has a loreal and a preocular on the left side and only a loreal on the right. T.M. 18,994 has only a loreal on both sides. In the four live adults from Lamberts Bay and the juvenile P.E.M. No. 1501/26 and the K.M. 1, 2 and 3, all have a loreal and preocular on both sides. K.M. 4 has only a loreal on the left and both on the right. K.M. 5 has a loreal on the left while the right side is too badly damaged for examination. It is therefore clear that this is a variable character and either a loreal alone or a loreal and preocular may be present.

Similar discrepancies also exist in the descriptions of the ventral scales. Boulenger (1910) describes the ventrals as "smooth, quadrangular, the outer pointed behind in 10 longitudinal and about 20 transverse series." Power (1933) describes the ventrals as "quadrangular, in 9 or 10 longitudinal series, strongly keeled and mucronate, excepting the 2 or 4 central series." FitzSimons (1943), "ventrals imbricate, quadrangular, a little broader than long, inner rows obtusely keeled, while outer rows are strongly keeled and mucronate, in 19-20 regular transverse and 10 longitudinal series." Loveridge (1944) describes the ventrals as "quadrangular, smooth, strongly imbricate, the lateral strongly keeled and shortly mucronate."

Examination of all the available specimens shows that the Type has ventrals smooth, quadrangular, imbricate and slightly broader than long except the 3 outer rows which are longer than broad, keeled and mucronate, the first four transverse rows from the forelimbs posteriorly are keeled and mucronate, progressively more so anteriorly until they meet the strongly keeled and mucronate throat scales. In T.M. 18, 449, K.M. 1 and the juvenile P.E.M. 1501/26, the description of the ventrals given by FitzSimons (1943) is correct. In K.M. 2, 3, 4 and 5 and the four P.E.M. adults, the ventrals are smooth, imbricate, quadrangular, broader than long, with 1 or at the most 3 outer rows keeled and mucronate. The ventrals should therefore be described as imbricate,

smooth or keeled, quadrangular, some or all mucronate. In this connection it is worth noting that in the juvenile P. E. M. 1501/26, the ventral keeling differs from that of its parent.

Due to the above and other discrepancies in the published descriptions, obviously due to paucity of material, the following description of the species is given based on the 12 available specimens.

DESCRIPTION

Head scales all heavily rugose. Rostral five-sided, much broader than high. Frontonasal quadrangular, as long as broad or broader than long, separated from the rostral and frontal, narrowly separated or just meeting loreal at a point on sides. Nasals in good median contact, not or slightly swollen. Nostril pierced in infero-posterior part of nasal and directed outwards. Prefrontals in short or long median contact. Frontal hexagonal, more than or less than twice as long as broad, broader anteriorly than posteriorly. Frontoparietals longer than or as long as broad. Interparietals between the two pairs of parietals, tetragonal, elongated anteriorly sometimes separating anterior parietals, which are longer than posterior.

Three to six occipitals, keeled, sometimes strongly so and pointed behind but never nearly so elongated as dorsals. Temporals strongly keeled, largest and shortly mucronate posteriorly. A single loreal or a loreal and preocular present. Two suboculars not bordering lip. Four or five upper labials, the largest posterior upper labial keeled. Three or four supraciliaries.

Mental five-sided, five lower labials, the third and fourth moderately keeled, the fifth strongly keeled and elongated. Five large sublabials, the fourth (largest) and the fifth strongly keeled and mucronate, all five carinated. A group of small obtusely or strongly keeled elongated chin shields between the second and third pairs of sublabials. Gulars large, imbricate strongly keeled and mucronate posteriorly. Ventral neck scales similar but much larger. Lateral neck scaling strongly keeled, raised and sometimes denticulate as well as mucronate.

Dorsal scales large, rugose, strongly keeled, mucronate and denticulate on the posterior edge, raised forming 14 to 18 regular longitudinal ridges. Fourteen transverse rows middorsally between the lateral folds. Dorsolaterally the scales are generally more spinose.

Ventrals imbricate, smooth or keeled, quadrangular with some or all mucronate, in 10 longitudinal and 19-20 transverse rows.

A pair of enlarged smooth quadrangular preanal plates. Posteriorly laterally to the vent is a laterally situated enlarged conelike, spinose, scale directed outwards. Tail composed of whorls of large elongate, rugose, strongly keeled, denticulate and mucronate scales, keels strongest superolaterally.

Limbs above, scales keeled, imbricate and mucronate, those on hind legs raised. Below, smooth or keeled and mucronate. Soles of feet spinose as are subdigital scales.

COLOUR

Pale grey with large irregular markings of dark grey dorsally and laterally. Head dark grey speckled with pale grey. Ventrally pale grey. Tail dark grey above, pale grey below. Upper and lower labials pale grey with darker spots becoming more numerous posteriorly until the fourth or fifth labials which are almost entirely darker greyish brown.

HABITS

The Lamberts Bay specimens were collected on the coastal scrub-covered dunes within a quarter of a mile from the sea. They were found both at the northern and southern edges of the town. FitzSimons (1943) stated "it is said that they live in holes in the sand, and certainly, their general cylindrical form would appear to preclude a rock-living habit." The four kept at the Snake Park have made no attempt to burrow but hide behind logs etc. in their display case. They were caught among dead sticks and leaves accumulated under shrubs (see Plate 1); also under empty cement pockets and pieces of corrugated asbestos lying among the scrub. They are very shy, scuttling off at the slightest sign of danger and due to their colouration are very difficult to detect among the greyish twigs and dead leaves.

This shyness probably explains the paucity of specimens collected even from a densely populated area such as Lamberts Bay. They are moreover, quick-moving and by no means easy to catch particularly when they seek refuge in the massed twigs and leaves accumulated under the dry coastal bushes. The four in captivity have never been seen to drink from their water dish but lap up drops of water if sprayed into the case.

As with other species of *Cordylus*, this species is ovoviparous, one young being born in the Snake Park on 17.5.65., while a female, K.M. No. 3 was found to contain two fully developed young. The juvenile born in Port Elizabeth measured 6.58 cm. (H. & B. 3.64, tail 2.94) at birth and weighed 1.5 grams. On 11.6.65 it still weighed 1.5 gms. but measured 7.18 cms. total length (H. & B. 3.68, tail 3.5). At its death on 18.7.65 it measured 7.27 cms. total length (H. & B. 3.77, tail 3.5).

The discovery of four specimens at Lamberts Bay extends the known range of *Cordylus macropholis* approximately 200 miles south as they were previously only recorded from Kleinsee. It is probable that they occur throughout the coastal sand dunes between these two localities.

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PORT ELIZABETH MUSEUM,
SNAKE PARK and OCEANARIUM

Observations on the Damara
Chameleon *Microsaura*
damarana Boulenger

SUMMARY

- (1) Observations on fifteen *Microsaura damarana* at Tsitsikama National Park are recorded.
- (2) The Damara Chameleon appears to have a definite home site, usually in Tree Ferns, to which it returns at night.
- (3) Sexual differences in colour and tail length are noted.
- (4) The known range of *M. damarana* is extended eastwards by 45 (forty-five) to 50 (fifty) miles.

Some interesting observations were made on the habits and habitat of fifteen specimens of the Damara Chameleon, *Microsaura damarana* while conducting an amphibian and reptile survey in the Tsitsikama National Park between the 12th and 14th June and the 10th and 12th July, 1965.

Yellowwoods *Podocarpus* Spp. Stinkwood, *Ocotea bullata*, Ironwoods *Linociera foveolata* and *Olea capensis* are some of the dominant trees forming a closed canopy some one hundred feet above the ground. The Chameleons occur in the undergrowth which receives very little direct sun and consists mainly of *Onderbos Trichocladus crinitus*, ferns *Blechnum* spp. and Tree Ferns *Cyathea capensis*. The latter invariably growing along the banks of small streams.

At night on the 13th June, while searching the banks of the Varkriver for amphibians, the Chief Nature Conservator of the Park, Mr. R. Liversidge and the author collected a female *M. damarana* which was sleeping hidden in the dead aplebia of a Tree Fern, *Cyathea capensis*. This specimen was five to six inches below the crown of the fern and about five and a half feet from the ground. A male *M. damarana* was found in a similar situation on another Tree fern a few feet away.

Before dawn on the 14th June the author searched the area of the "Big Tree" near the Storms River Bridge. Another two female *M. damarana* were found in almost identical sleeping positions as the pair from Varkriver. During the

morning two more female *M. damarana* were collected curled up among the aplebia and young fronds in the crowns of two tree ferns about eight feet apart. Due to their posture, with coiled tail, which resembled the coiled shoot of a frond in the crown of the fern, they were extremely difficult to detect.

The Big Tree area on the night of the 10th July produced a further two chameleons "A" & "B" sleeping in the dead aplebia on the trunk of Tree ferns - these two were not taken. The night of the 11th July a *M. damarana* was found on a fern *Blechnum capense* at the base of a rocky undercut section of the Varkriver banks, in an area that had been searched that afternoon. The chameleon was not in the normal sleeping position with coiled tail but was straddled over two fronds with its tail straight. In the same area a chameleon was found in the normal sleeping posture on a fern frond *Polystichum adiantiforme* about twelve to fourteen inches from the ground. At the Big Tree area a female was collected sleeping on Onderbos, *Trichodadus crinitus* about six feet from the ground, a Juvenile was found on the frond of a tree fern and a male in the dry aplebia on the side of a tree fern. Another "C" was found in a small hollow in the base of a fallen tree, the latter chameleon was not taken.

During late afternoon on the 11th July the two Chameleons "A" and "B", were in the same situations as the previous night. Unfortunately "A" was disturbed and moved into the fronds of the fern where it was well concealed always keeping, if possible, the stem of the frond between itself and the observer. "A" spent the night (11th July) in the fronds. "B" was undisturbed. The following morning (12th July) at 7.20 a.m. "A" and "B" had not moved from the positions of the night before. "C" was still in its log but was unfortunately disturbed and moved onto a root about two feet away. At 6.30 p.m. it was on Onderbos some three and a half feet from the log. By 8.30 a.m. (12th July) "A" had moved from its sleeping position in the fern fronds and despite a diligent search was not found. "A" was back in its original position on the trunk of the tree fern at 6.30 p.m. Although observed for some hours in the morning "B" remained in the same position as the previous night and always endeavoured to keep its back towards the observer. It would appear from these observations that *M. damarana* has a fixed home site to which it normally returns at night.

The four chameleons collected on a cold night (13th June) were white in colour while those found during the warmer nights of the 10th and 11th July were a bright apple green. As in other chameleons (Ditmars, 1922) their colours vary greatly according to light intensity and temperature. At 7.50 a.m. (12th July) "B" had gone dark brown and green, making it very difficult to detect on the side of the fern, the temperature was 14°C. At 6.30 p.m. when the temperature was 17.5°C., A and B were bright apple green. The males of *M. damarana* can become highly coloured in shades of green, blue, purple, yellow and black (see Plate 2). As yet a highly coloured female has not been observed; they appear to remain light to dark shades of brown or green, occasionally there is a pinky red area above and posterior to the forelimbs.



PLATE I — *CORDYLUS MACROPHOLIS* in its natural habitat near Lambert's Bay



PLATE II — MALE *MICROSAURA DAMARANA*



SPENCE - DAMARA CHAMELEON

By dissection the females were found to contain eggs numbering in P. E. M. 1501/14, seven, 1501/15, nine, 1501/16, six, 1501/17, ten, 1501/19, twenty, 1501/20, seven, 1501/21, fourteen. According to local residents the young *M. damarana* are born in late summer.

Their young, as in other species of *Microsaura* (FitzSimons (1943) and personal observations of *M. ventralis ventralis*), are deposited by the female in transparent membranous eggs, which have a sticky covering and adhere to the first branch or twig they touch. The young immediately break out of the membranes and are fully independent. The juvenile *M. damarana* collected has a total length of 55.4 mm. At this size it was coloured in shades of brown and green.

The largest male *M. damarana* found has a total length of 192.5 mm. and the total length for the largest female was 175.8 mm. while the largest specimen cited by FitzSimons (1943) is 167.5 mm. All body length measurements were taken immediately after death. It can be seen from Table 1 that there is a tendency for the males to have comparatively longer tails than the females.

The known distribution of *M. damarana* appears to be restricted to the Knysna Coastal Forest, between George and Stormsriver, FitzSimons (1943) records specimens from George, Knysna, Deepwalls and Avontuur. Thus these records from Coldstream and Stormsriver extend the known range eastwards by 45 to 50 miles.

ACKNOWLEDGEMENTS

I am grateful to the National Parks Board for permission to collect amphibia and reptiles in the Tsitsikama National Park and for financial assistance, also the Director and Board of Trustees of the P. E. Museum, Snake Park and Oceanarium for the use of a vehicle. Special thanks to Mr. R. Liversidge for assisting in the collection of specimens and Mrs. M. Witcher for one chameleon she found in her garden.

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TABLE 1
MEASUREMENTS OF MICROSaura DAMARANA

P. E. M. No.	Sex	Body Length	Tail length	Total length	% of tail to Total length
1501/14	♀	68.8 m.m.	83.0 m.m.	151.8 m.m.	54.7
/15	♀	59.7	68.3	128.0	53.4
/16	♀	51.6	58.5	110.1	53.1
/17	♀	68.5	82.8	151.3	54.7
/19	♀	78.3	97.5	175.8	55.5
/20	♀	64.6	67.0	131.6	50.9
/21	♀	72.0	82.2	154.2	53.3
/18	♂	78.0	114.5	192.5	59.5
/22	♂	62.5	77.5	140.0	55.4
/23	♂	56.4	76.5	132.9	57.6
/24	♂	54.6	70.6	125.2	56.5
Mean ♀	=	53.6%			
Mean ♂	=	57.2%			

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PORT ELIZABETH MUSEUM,
SNAKE PARK and OCEANARIUM

The Genus *Pachydactylus*
(Part 1)

SUMMARY

The range of variation in topotypical material of *Pachydactylus serval* is presented and the conclusion drawn is that *P. purcelli* and *P. onsecpensis* should be regarded as races of *P. serval*. The relationship of *P. serval* to *P. weberi* is also discussed.

INTRODUCTION

South African forms of the genus *Pachydactylus* have caused a great deal of taxonomic difficulty, more perhaps than any other vertebrate group, and the purpose of this series of papers is to attempt some clarification, based on the extensive series of geckoes of this genus collected by the Port Elizabeth Museum.

This first paper deals solely with the difficult group of depressed, rupicolous geckoes of the west coast, as far north as Helmeringhausen. The forms occurring further north will be dealt with in subsequent papers.

The species under discussion are all strongly depressed, rupicolous forms living in narrow crevices in hard rocks such as granites, sandstones, quartzites, vein quartz, dolerites and various lavas. They are often very localised in distribution and when collecting in the field the writers found that, if no geckoes or eggs are seen within twenty minutes or so, it is better to move on to another locality. Where they occur they are often common and a dozen may be collected in a short space of time. Being strictly nocturnal and remaining deep in crevices during the day, it is not surprising that the first species was not described until 1907, being overlooked even by such eagle-eyed collectors as Andrew Smith. When disturbed they are quick and extremely agile, particularly at night, when they are even more difficult to catch than during the day.

The geckoes to be dealt with here were originally described as the following species and sub-species:

1. *Pachydactylus weberi* Roux 1907
2. *Pachydactylus capensis gariesensis* Hewitt 1932
3. *Pachydactylus weberi acuminatus* FitzSimons 1941

.....

4. *Pachydactylus serval* Werner 1910
serval group 5. *Pachydactylus purcelli* Boulenger 1910
 6. *Pachydactylus montanus* Methuen & Hewitt 1914
 7. *Pachydactylus montanus onscepensis* Hewitt 1935

Since publication of the original descriptions listed above, there have been three important reviews and summaries of the taxonomic position: FitzSimons (1943), Loveridge (1947) and Mertens (1955). Mertens' paper only covers South West Africa so that he does not deal with the southern races of *weberi*.

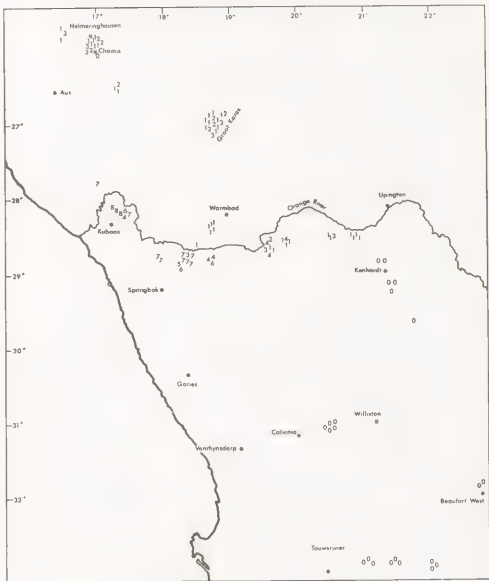
The classifications suggested by these three writers are as follows:

FitzSimons (1943)	Loveridge (1947)	Mertens (1955)
<i>P. weberi weberi</i>	<i>P. weberi weberi</i>	-
<i>w. gariesensis</i>	<i>w. gariesensis</i>	-
<i>w. acuminatus</i>	<i>w. acuminatus</i>	<i>w. acuminatus</i>
.....		
<i>P. serval</i>	<i>P. serval</i>	<i>P. serval</i>
<i>purcelli</i>	<i>purcelli</i>	<i>purcelli</i>
<i>montanus montanus</i>	= <i>serval</i>	= <i>serval</i>
<i>m. onscepensis</i>	= <i>serval</i>	= <i>serval</i>

At first glance the above table appears to show fairly close agreement, both Loveridge and Mertens agreeing that only three species are involved and that *montanus* and *onscepensis* are synonymous with *serval*. Furthermore in a footnote, Loveridge quotes FitzSimons as agreeing re *onscepensis* and states: "As FitzSimons remarked that the Seeheim gecko was without tubercles, it seemed possible that it was a *P. purcelli*. In replying to this suggestion, however, FitzSimons (I. II. 44) assures me that in all other respects this young gecko is inseparable from *P. m. onscepensis* i. e. *purcelli* (sic) as here understood, a synonymizing of *onscepensis* with which Dr. FitzSimons concurs". However, in the main text Loveridge synonymizes *P. m. onscepensis* with *serval* (not *purcelli* as stated in the footnote) so presumably he meant that FitzSimons agrees that *P. m. onscepensis* is synonymous with *serval*. However, this still leaves the status of *purcelli* in relation to the others undecided.

The main criteria used by the above writers for separating the various forms are the degree of heterogeneity in the dorsal scaling and the nasal characters. In the *weberi* group the rostral does not enter the nostril; in the *serval* group it does.

As *P. serval* was the first species (in the *serval* group) to be described, by Werner in 1910, the writers' first tasks were to examine the type and collect topotypical material to establish the range of variation in this species. Fortunately, Mr. R. Liversidge of this Museum happened to be going to East Berlin and kindly examined the type for us. He reported *inter alia* that the rostral

McLACHLAN, SPENCE - THE GENUS *PACHYDACTYLUS*

MAP SHOWING GEOGRAPHICAL DISTRIBUTION AND PER CENT
OF P. SERVAL AND RELATED FORMS

and first upper labial enter the nostril and that the dorsal scaling was homogeneous and lacked tubercles.

FitzSimons (1943), when discussing the status of *P. serval* remarked, "There are apparently no specimens of this species in the South African Museums, and it would appear to be of rare occurrence".

To collect topotypical material the writers visited the type-locality, Chamis (Great Namaqualand) just south of Helmeringhausen. This farm has been divided and the northern half, on which the old homestead still stands is now known as Mooifontein. The southern half is Chamis Süd. Diligent search in the neighbourhood of the homestead (based on the assumption that the original collector was staying there) failed to reveal any geckoes but the rock is unsuitable, being massive dolomites of the Nama System, the cracks and joints full of fine dust which apparently rendered them unacceptable to geckoes. However, about 2 miles north of the homestead a small quartz vein yielded 2 specimens while 5 miles north of the house, another 10 were extracted from a similar but larger quartz vein.

This topotypical material agrees with the type as far as the nasal characters are concerned; in all cases the rostral enters the nostril. As far as the dorsal scaling is concerned, the 12 specimens are variable. The extent of this variation is shown in Table 1. The actual size of the ground scales and of the dorsal tubercles was measured in each specimen and the approximate percentage of the body (between the limbs) which is covered by tubercles was estimated. As may be seen from Table 1, the size of the ground scales varies from 8 to 10* in the adult specimens. The size of the enlarged tubercles being in the range 14 to 18 (excluding No. 1494/35 which is only sub-adult) and the percentage of tubercles present varies from 0 (as in the type) to 30%. The average cover being about 15%. It should be stated immediately that these percentage figures are no more than estimations, as it is very difficult to give precise measurements of the degree of tuberculation of the dorsal surface. One complication is that some specimens have enlarged ground scales which are not keeled and are therefore not treated as tubercles in Table 1. The percentage figures refer to keeled tubercles and are intended as a rough guide to the rugosity of the dorsal scaling. When tubercles cover 40% or more of the back, they tend to form distinct longitudinal rows.

* One unit = one fortieth of a millimetre.

TABLE 1

PERCENTAGE OF DORSAL SURFACE COVERED IN TUBERCLES;
LENGTH OF HEAD AND BODY; SIZE OF TUBERCLES AND SIZE
OF GROUND SCALES

	% tuberculation of dorsal surface		Length Head & Body	Average size of 10 tubercles	Average size ground scales
1494/35	Chamis	20% (2)	3.1 cms.	10.4	6.5
1494/36	Chamis	10" (1)	3.5 "	14.3	8.1
1494/37	5m. N. Chamis	10" (1)	3.7 "	15.4	10.8
1494/38	"	30" (3)	3.0 "	15.0	7.8
1494/39	"	20" (2)	3.8 "	18.2	9.8
1494/40	"	10" (1)	4.0 "	16.5	10.0
1494/41	"	20" (2)	3.8 "	14.8	9.1
1494/42	"	10" (1)	3.9 "	15.9	9.0
1494/43	"	20" (2)	3.5 "	17.3	9.1
1494/44	"	0" (0)	2.5 "	-	8.1
1494/45	"	10" (1)	4.0 "	15.3	8.9
1494/46	"	10" (1)	3.0 "	16.0	7.9

With this topotypical material available it is possible to compare geckoes of the *serval* group occurring over the whole area from Touws River in the south to Chamis and Barby in the north. Throughout this range, the nasal character (rostral entering the nostril) was accepted as the main distinguishing feature of members of the *serval* group as opposed to those of the *weberi* group. Coloration too is remarkably constant and even specimens of *purcelli* from the southern Karoo are very similar to examples of *serval* from Chamis. On the other hand the degree of tuberculation of the dorsal surface is extremely variable. On Map 1, an attempt has been made to plot this variation geographically. Each number represents the percentage (divided by 10) of the dorsal surface of each specimen estimated to be covered in tubercles. Thus a figure 3 indicates that 30% of the dorsal surface, between the fore and hind limbs is covered with tubercles.

It will be noted that specimens from Touws River, Beaufort West, between Williston and Calvinia and from an area stretching as an arc northwards through Kenhardt and Warmbad to Konkiep, Chamis and Barby, are all characterised by almost homogeneous dorsal scaling. There is, however, a distinct increase in tubercles in specimens from north of Warmbad. The greatest increase of all, however, occurs along the lower Orange River from East to West. In Fig. 1, the degree of tuberculation of the specimens collected along the south bank of the river is plotted against mileage along the river, from Kakamas in the East to the Tatasberg region of the Richtersveld in the West. It will be seen that specimens

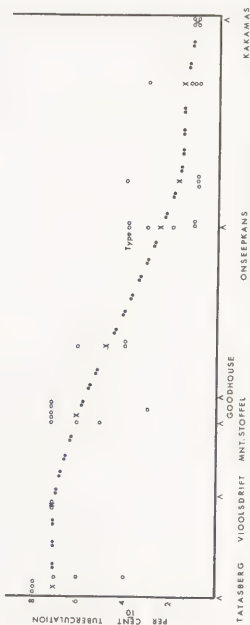


Figure 1
Graph showing increase in tuberculation from East to West along Orange River. O = specimen, X = average.

from Kakamas have little or no dorsal tuberculation and approach *purcelli* in this respect but as one moves west the number of tubercles present increases until in the Richtersveld the dorsal scaling approaches that found in *P. weberi*. Furthermore in two specimens from the Obib Hills, caught on the same outcrop of rock, one has the rostral entering the nostril and the other does not. This nasal character and the absence of large tubercles on the hind limbs serve to distinguish members of the *serval* group from *weberi* even when, as in this case, the two occur together.

Within the *serval* group, it seems clear that only one *species* is involved. Specimens of *purcelli* from the southern Karoo are extremely close to some of the topotypical material from Chamis. Furthermore the range of variation of *serval* is sufficient to cover most specimens over the whole area except those along the Orange River (which are too rugose) and those from the Karoo which are too homogeneous dorsally. *Pachydactylus purcelli* is therefore considered to be a southern race of *serval* while the name *onscepsensis* is available for the forms along the lower Orange River from Onseepkans to the Richtersveld. The type of *onscepsensis* was examined and would be rated by the writers as having about 40% of the dorsal surface covered with tubercles. The nominate race would cover specimens north of the Orange River away from the valley itself. *P. montanus* is considered synonymous with *serval*.

It is interesting to speculate on the reasons for the great increase in tubercles found in specimens from the Orange River valley. It will be noted from Map 1 that it is only when the river drops below the Aughrabies falls into the relatively low-lying gorges that the increase in tubercles begins. The specimens from south-west of Warmbad are interesting in this connection. They are almost devoid of tubercles but were collected at a height of 1200 metres whereas the river nearby is only 300 metres above sea level. Furthermore Goodhouse has the unenviable reputation of being the hottest place in South Africa and the official gross annual evaporation figures for three stations along the lower Orange River are as follows: Vioolsdrift 104, Kakamas 110 and Buchberg 100. Away from the river they are much lower: Sakrivier 81, Brandvlei 69 and Carnarvon 92. The increased incidence of tubercles appear to be a reaction to the extremely high temperatures coupled with high aridity. It will be noticed that Kakamas has a high evaporation figure but the geckoes there are not strongly tuberculated. Temperatures at Kakamas, though high are probably not as high as along the gorges of the lower river; unfortunately comprehensive figures are not available.

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A New Species of **Barbus**
(Pisces, Cyprinidae) from the
Sabie River, North-Eastern
Transvaal

By courtesy of the Director, Department of Nature Conservation, Pretoria, and in collaboration with Mr. P.J. le Roux, Senior Fisheries Officer of the Lydenburg Provincial Fisheries Institute, a survey has been completed of the fishes collected by the Institute. Material collected by Dr. U. de V. Pienaar, Biologist, Kruger National Park, was also placed at my disposal. The results of this investigation, which is part of a research programme sponsored by the Council for Scientific and Industrial Research, Pretoria, will be published in more detail. This preliminary note, which includes the description of a new species of **Barbus**, draws attention to some new distribution records.

Lydenburg is ideally situated on the north-eastern Transvaal highveld for easy access to tributaries of four large drainage systems, the Vaal-Orange, Limpopo, Incomati and Pongolo Rivers. In the Lake Chrissie area, for example, a circle with a radius of twenty miles would embrace the headwaters of tributaries of all four of these drainage basins. Exploration of these highveld streams has produced some interesting results, one of the first being the discovery of a population of **Kneria auriculata** (Pellegrin) in a small tributary of the Crocodile River, Incomati system. Previous to this the most southerly record of **Kneria auriculata**, which is widely distributed in the Zambezi River system, was from numerous tributaries of the Sabi-Lundi system of Rhodesia. This species has not, as yet, been recorded from any part of the Limpopo River system.

Another interesting discovery was a population of **Barbus neefi** Greenwood in a dam on a tributary of the Ohrigstad River, Limpopo system. This species, described from the headwaters of the Upper Zambezi River (Greenwood 1962), has not been recognised in any collections made from intervening river systems. In view of the great distance between the type locality and the Ohrigstad River specimens were sent to Dr. P.H. Greenwood of the British Museum (Natural History) who kindly confirmed the diagnosis (Greenwood in litt., 1965).

Greenwald (1958), his material covering both the Incomati and Pongolo River systems, confirmed the record by Gilchrist & Thompson (1913) of **Barbus**

unitaeniatus Günther from the Incomati River. A recent and very extensive collection of small **Barbus** submitted by le Roux showed that it was difficult to separate **B. labialis** G. & T. (= **B. macrurus** G. & T.) taken from the Limpopo system and having 14 scales around the caudal peduncle, from **B. unitaeniatus** of the Incomati system with the same squamation characteristics. Furthermore it was not possible to separate **B. labialis** with 16 scales around the caudal peduncle from material collected by Bell-Cross in the Mwekera River of the Kafue system, Zambia. Material from the Okavango River and the Middle Zambezi system proved equally as difficult to separate from Transvaal specimens. A large collection representing the **labialis/unitaeniatus** complex from widely distributed points was therefore sent to Greenwood for detailed examination and comparison with type and topotype material in the British Museum (Natural History). As a result of this investigation Greenwood (in litt. 1965) came to the conclusion that **B. unitaeniatus** Günther, like many other species of African **Barbus**, was a polytypic species with a wide distribution from the Pongolo River in the south to the Zambezi and Angolan rivers in the north. **Barbus labialis** G. & T. should therefore be regarded as a synonym of **Barbus unitaeniatus** Günther.

The identification of the Angolan species **Barbus argenteus** Günther, taken from highveld tributaries of the Incomati and Pongolo River systems, was confirmed by Greenwood (in litt. 1962). Like **B. neefi**, **B. argenteus** has not been recognised in collections made from intervening drainage basins. If we include **B. mattozi** (= **B. rapax**), **B. marequensis** (= **B. codringtoni**), **B. paludinosus**, **B. eutaenia**, **B. lincomaculatus**, **B. viviparus** and **B. barotseensis** with **B. unitaeniatus**, **B. neefi** and **B. argenteus** it is interesting to note how many of the **Barbus** of the Transvaal occur in the region embracing the Cunene, Okavango, Mashu and Upper Zambezi Rivers. For zoogeographical purposes it is of importance to note that Bond (1964, p. 49), in his discussion on the origin of the Victoria Falls, states: "It seems possible that in the geological past the Mashu and Upper Zambezi flowed south through the present Makarikari Lake and joined the Limpopo Valley, and that the Middle Zambezi was quite a separate river system."

The few species of **Barbus** endemic to the Transvaal region are remarkably restricted in distribution. **Barbus motebensis** Steindachner, a species resembling **B. anoplus** but differing in that there are always two pairs of barbels and males develop conical tubercles on the snout, is restricted to the southern highveld tributaries of the Limpopo where it is fairly common, but is absent from those tributaries rising in Rhodesia. **Barbus treurensis** Groenewald, quite distinct from other Transvaal **Barbus**, is, from recent collecting, restricted to its type locality, the Treur River, a highveld tributary of the Blyde River which flows into the Limpopo. A thorough search by Le Roux and his colleagues in the Sabie River failed to produce any specimens of **B. treurensis** but it did lead to the discovery of an undescribed species, apparently endemic to the Sabie and which

JUBB - A NEW SPECIES OF BARBUS

is described below. Another species endemic to the Incomati River system is, of course, *Barbus annectens* Gilchrist and Thompson which was described originally from the Sabie River from material collected in the Kruger National Park. This species is well represented in material submitted by Pienaar.

Barbus brevipinnis sp.n. Text-fig. 1.

HOLOTYPE

An adult female 46 mm. standard length collected by the Provincial Fisheries Institute, Lydenburg, in the Sabie River, Incomati River system, Pilgrim's Rest District. Albany Museum Registered No. P. F. 1072, with 20 paratypes, P. F. Nos. 1073-1092, collected at the same locality.



Figure 1

Barbus brevipinnis sp. nov. Type specimen.

DESCRIPTION

In percentage of standard length: fork length 112.0-116.0, depth 26.0-28.7, length of head 23.4-26.1, lateral eye diameter 6.0 (adult) - 8.1 (young), snout length 4.3-4.8, interorbital width 10.9-12.9, caudal peduncle length 22.8-26.0, peduncle depth 11.7-13.7, longest dorsal ray 16.3-21.2, longest pectoral ray 12.9-15.8, longest ventral ray 12.2-15.8, longest anal ray 10.4-15.3, length of anterior barbel 0 (2 specimens) - 3.3, length of posterior barbel 0.1 (young) - 4.7 (adult). Snout tip to origin of pectoral 23.4-27.4, origin of ventral 48.4-51.6, original of dorsal 50.6-54.5, origin of anal 66.7-70.7.

Gill rakers short and thick, 10-12 on the whole anterior arch. Pharyngeal teeth in three series 1:3:4 - 4:3:1, all being stout and hooked.

Scales radiately striated with 5-11 striae. Lateral line 27-30, dorsal to lateral line 4, lateral line to origin of ventral 2, predorsal scales 10-11, caudal peduncle scales 12 (range 10-12). Dorsal fin III 7-8, the last branched ray double, anal III 5. The type specimen has 7 branched rays in the dorsal fin.

Specimens preserved in formalin have a dark lateral stripe which starts at the tip of the snout and follows the dorsal contour joining the lateral line posterior to the anal fin. This lateral stripe may be broken into a series of dots and dashes. In some specimens there is a series of small dots along the dorsal surface, near

its apex, between the dorsal fin and the caudal peduncle. There is a faint spot at the base of the anal fin and another at the base of each pectoral fin. In live fishes the dark body markings are fainter, the dorsal surface a dark olive with golden glints to the scales on the sides and belly. The operculum is very golden and also the iris of the eye. The lateral line tubules are edged with dark pigment which becomes prominent in preserved specimens.

B. brevipinnis is a small species which does not attain a fork length of much over 50 mm. Superficially it resembles *B. viviparus* M. Weber but the small protractile mouth with its very short barbels, the lower dorsal and anal fin, as well as the shorter pectoral and ventral fins help to distinguish it from that species. Through the courtesy of the Director of the South African Museum, Mr. R.S. Crass, Fisheries Research Officer, Pietermaritzburg, and Dr. Pienaar of the Kruger National Park it has been possible to compare *B. brevipinnis* directly with paratypes of *B. viviparus* (S.A.M. 22083), housed in the South African Museum, and a number of specimens of *B. viviparus* from widely distributed points in Natal and the Kruger National Park. The following significant differences in percentage of standard length were obtained:

	<i>B. brevipinnis</i> sp.n.	<i>B. viviparus</i>
Dorsal height	16.3 - 21.2	21.6 - 24.4
Length of pectoral	12.9 - 15.8	16.2 - 18.4
Length of ventral	12.2 - 15.8	16.6 - 18.4
Length of head	23.4 - 26.1	24.4 - 25.6
Depth	26.0 - 28.7	25.6 - 29.6
Anterior barbel	0.0 - 3.3	5.1 - 6.1
Posterior barbel	0.1 - 4.7	7.7 - 9.0

I wish to thank Mr. P.J. le Roux for supplying both living and preserved material of this species, and Mr. R.S. Crass and Dr. P.H. Greenwood for examining and commenting on preserved material. Mrs. H.M. Jubb very kindly prepared the illustration of *Barbus brevipinnis*.

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Note on *Labeo Quathlambae*
Barnard, 1938

There are two important reasons why this note on *Labeo quathlambae* is being published. The first is that the species is known only from the type series collected in a tributary of the upper Umkomazana River, Umkomaas River system, in 1938, and has been found in no other river system. It was apparently confined ecologically to the cold waters of this Drakensberg stream which have been stocked with *Salmo trutta*, the exotic brown trout. The failure of recent collecting to bring to light any specimens of *quathlambae* might be due to extermination by this introduced predator (Crass, 1964).

The second important reason is that *quathlambae* is not a *Labeo* and, of more importance still, is quite unique in that it is not closely related to any known African Cyprinid. In describing *quathlambae* Barnard noted some curious features about this species which created some doubt about whether it should be assigned to the genus *Labeo* or *Barbus*. As recent research indicated that *quathlambae*, judged by its description, could not be fitted to a key for the identification of the *Labeo* it was decided to examine type material.

By courtesy of the Director of the South African Museum two of the syntypes, S.A.M. 19018, were made available for examination, the one 80 mm. standard length (fork length 90 mm.) and the other 81 mm. standard length (fork length 91 mm.). Both were found to be ovigerous females, the former showing remarkable agreement with the illustration of *quathlambae* in Barnard's paper. On examination of the specimens it was found that, in addition to the features such as fin-formula, position of the dorsal fin relative to the ventrals, and the few short, stout gill rakers previously noted by Barnard, the shape and position of the mouth, as well as the character of the digestive tract and the pharyngeal teeth indicated that *quathlambae* could not be assigned to the genus *Labeo*.

As regards the shape and position of the mouth of *quathlambae*, it was possible to compare this species directly with other *Labeo* from the rivers of southern Africa. This was carried out in accordance with the general characters and functional morphology of the feeding mechanisms of some African Cyprinidae described in such detail by Matthes (1963). The intestine of a *Labeo* is extremely

long, the ratio total intestine length divided by the standard length of the fish being as much as 14-21; this same ratio for *quathlambae* was found to be less than 1. The intestine of *quathlambae* is extremely short and resembles that of a predatory *Barbus*. The pharyngeal teeth of *Labeo* are homodont and placed in three rows, the formula being 2-3;3-4;5-5;4-3;3-2. The crowns, which lie close together, tend to be flattened. Those of *quathlambae*, both in character, being distinctly pointed and hooked, and formula, 2-3;4-4;3-2, were found to resemble those of a *Barilius* and not a *Barbus*.

As the presence of this unique Cyprinid, isolated in a Drakensburg stream and apparently unrelated to any known African Cyprinid, is a problem of considerable interest requiring an explanation, the Director of the South African Museum has very kindly forwarded further material to Dr. P.H. Greenwood of the British Museum (Natural History) for examination and comparison with Cyprinid material at his disposal.

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D. H. KENNELLY
EAST LONDON MUSEUM

Notes on Charonia
Pustulata (Euthyme)
South Africa's Largest
Gastropod

The East London Museum has a large number of examples of this species, ranging in size from juvenile to adult. An examination of these shells, and reference to notes made in the field, has produced the information presented in this paper.

The largest example in the museum collection is a dead shell, ex Trawler off Bird Island in 30/40 fathoms, measuring 225 x 125 m. m.

Some years ago, while at Jeffrey's Bay, the writer was shown a larger shell of about 250/300 m. m. in length, with a width in proportion. This specimen had become exposed in a large sand dune, some little distance from the high water mark, through the action of a strong South Easterly wind. It certainly is not a fossil nor a semi fossil shell.

Juvenile shells of *pustulata* are usually smooth until they attain 50/60 m. m. in length, when the nodules begin to appear.

With regard to the colour of shells, available literature states this to be yellowish, or olivaceous brown, with irregular darker brown patches and marks. The present investigation shows that the colours become deeper as one travels eastwards. H. J. Koch (1949) has already recorded this increase in depth of colour for *Patella miniata* Born.

Live and fresh dead shells, varying in colour from yellowish to a deep orange, have been collected at Jeffrey's Bay, also specimens of the more usual brown colour.

Further East from East London to Kei Mouth all specimens seen are of a dark brown, or of deep orange colour. At Bonza Bay a collector, Mrs. M. A. Rix, found a live example of 150 mm. coloured deep orange.

Investigation on the reefs at various localities from East London to Kei Mouth has produced live specimens of 120/125 m. m., which appear to be stunted in growth. These shells are very thick in build and more or less encrusted with barnacles, worm tubes and other marine growths. One specimen taken alive at Haga Haga is very stunted, and its shell is badly corroded by borers.

In the same localities where the stunted shells were found, other live examples were taken - a little larger in size, which appear to be normal. These latter shells are not so heavy in build, and are devoid of sea growths or nearly so. It appears reasonable to assume that stunted shells are those which have lived for a considerable time in rock pools on the reef. Those examples which appear normal may possibly be individuals that have more recently made their way to the reefs from a habitat in deeper water.

Further investigation is now necessary to obtain additional data which may answer the problems confronting the student of Mollusca.

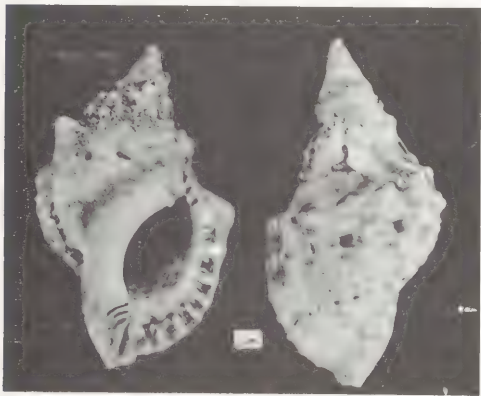


Plate 1
Charonia pustulata Normal specimens
East London



Plate 2

Charonia pustulata Stunted specimen Haga
Haga, E. L.

SUMMARY

The maximum size which may be attained by *C. pustulata*, remains to be established.

Live specimens of different sizes, which have orange coloured shells, have been collected. This appears to indicate that the colour is normal within the species, and not the result of beach exposure.

An allied species - *Charonia rubicunda* Perry, in South Australia, also exhibits both the brown and the orange colour.

More investigation into the animals living on the reefs is needed, as their presence may be due to accident, or by design for reasons unknown.

ACKNOWLEDGEMENTS

The author expresses his thanks to the Chairman and the Board of Trustees of the East London Museum for permission to undertake this work.

To the Director, Miss M. Courtenay-Latimer, for her encouragement, and to Mr. G.G. Smith, Chairman of the Board of Trustees, for the photographs illustrating this paper.







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Alia

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Vol. V

Supplementary List and Index

to

AN ANNOTATED LIST OF
RADIOCARBON DATES FOR
SUB-SAHARAN AFRICA

by

J. DEACON

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ALBANY MUSEUM, GRAHAMSTOWN

JANUARY 1968

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to
**AN ANNOTATED LIST OF
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**SUPPLEMENTARY LIST AND INDEX TO AN ANNOTATED LIST
OF RADIOCARBON DATES FOR SUB-SAHARAN AFRICA**

**J. Deacon
Albany Museum, Grahamstown**

INTRODUCTION

In the paper "An annotated list of radiocarbon dates for sub-Saharan Africa" (10), several dates were inadvertently omitted. The purpose of this supplementary list is to include the omitted dates and to make the lists as complete as available information would allow for dates published up to the end of 1964. An index to both lists is appended.

The structure of this supplementary list is as in the earlier paper except that the relevant references have been grouped together at the end. Since the majority of the dates have had very little information published about their associations and implications of the dating, the additional notes are for the most part brief.

SUPPLEMENT TO ANNALS OF CAPE PROVINCIAL MUSEUMS VOL. V

A. GEOLOGICAL AND TREE RING DATES

b. CENTRAL AFRICA

Lab. No.	Date $\frac{B.P.}{B.C.}$	Site	Associations	Sample	Reference
1. C-697	6098 ± 300 4148 BC	Lonze Forest Zambia	Unspecified	Charcoal	13
2. C-660	3585 ± 260 1635 BC	"	"	"	"
3. C-661	av. 3500 ± 225 1650 BC	"	"	"	14

c. EAST AFRICA

4. A-359	$17,200 \pm 330$ 15,250 BC	Dahlaç Archipelago, Ethiopia	Fossil reef dating last uplift of Archipelago	Carbonate	1
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d. WEST AFRICA

5. Not published	$12,250 \pm 240$ 10,300 BC	Niger Delta, Nigeria	Sedimentation of the delta	Not published	3
6. "	$10,750 \pm 250$ 8800 BC	"	" " "	" "	3
7. "	3380 ± 150 1430 BC	"	" " "	" "	"
8. "	1190 ± 150 760 AD	"	" " "	" "	"
9. NZ-284	3885 ± 125 1935 BC	"	Dead coral banks, depth 312 ft.	Coral	4
10. NZ-283	2920 ± 100 970 BC	"	Dead coral banks, depth 270 ft.	"	"
11. GRO-1194	5570 ± 70 3620 BC	Takoradi, Ghana	Dates Second Holocene Transgression	Wood	7
12. T-4013	5900 ± 140 3950 BC	Bougdouma, Manga, Niger	Beach at 2.50 m.	Silt	2
13. T-404	5570 ± 120 3620 BC	Nouakchott, Mauretania	Raised beach at + 1m - + 2m.	Shell	3
14. T-403	1910 ± 100 40 AD	Fann, Dakar, Senegal	Raised Beach at + 2m.	Shell	3

ADDITIONAL NOTES ON GEOLOGICAL DATES

1. **C-697 Lonze Forest, Zambia**6098 $\pm$ 300

4148 BC

Charcoal from a depth of 12ft. in the Kalahari Sand in a pit 8ft. in diameter in the Lonze Forest, Barotseland. The sides of the pit were scraped at 12ft. to expose the charcoal. It is not a continuous horizon. The charcoal was found in seven places. Variation in depth between the lowest and highest samples did not exceed 8 ins. Collected by J. Desmond Clark, submitted by H. L. Movius Jr. (13). Details of the implication of this date has not yet been published (see also (10), p. 14).

2. **C-660 Lonze Forest, Zambia**3585 $\pm$ 260

1636 BC

Charcoal from a newly developed pit in the Lonze Forest, Barotseland, taken at the 5ft. level (4ft. 10ins. to 5ft. 3ins.). There was no evidence of tree roots and it is believed the charcoal was free from root contamination. Collected by J. Desmond Clark and submitted by H. L. Movius Jr. (13, 10 p. 14).

3. **C-661 Lonze Forest, Zambia**3210 $\pm$ 2504300 $\pm$ 500average 3500 $\pm$ 225

1650 BC

Charcoal from newly developed pit in the Lonze Forest, Barotseland, taken at a depth of 10ft. to 10ft. 4ins. at the site from which Sample C-660 was taken. Collected and submitted as above. (14, 10 p. 14).

4. **A-359 Dahlac Archipelago, Ethiopia**17,200 $\pm$ 330

15,250 BC

Carbonate sample from fossil reef ca. 6m. above sea level in the Dahlac Archipelago, east of Massaua, Ethiopia, in the south Red Sea (15° 53' N; 39° 55' E). Collected in 1962 and submitted by Yaacov Nir of Israel Geological Survey, Jerusalem. **Comment:** "Dahlac Archipelago is situated at the western border of the Syrian-African rift system and at the northern edge of the Dankilian Horst. According to Nir, this sample dates the time of the last uplift of the Archipelago and confirms the very recent age of the Dahlac. Sample was washed in dilute HCl before hydrolysis to remove possible recent contamination." (1).

5-8. **Laboratory Numbers not published. Niger Delta Series, Nigeria**

See condensed list.

Samples date the rate of sedimentation in the modern delta of the river Niger in West Africa. Collected by J. R. L. Allen, University of Reading, England (2, 3, 5, 8).

9-10. **Coral Series, Niger Delta, Nigeria**

NZ-284 Depth of 312 ft.

3885 $\pm$ 125

1935 BC

SUPPLEMENT TO ANNALS OF CAPE PROVINCIAL MUSEUMS VOL. V

NZ-283 Depth of 270ft.

2920 ± 100
970 BC

Ahermatypic corals, *Dendrophyllia ramea* and *Madracis asperula* from coral banks on the surface of transgressive Holocene sands. Banks are no longer living and their depth when alive cannot be deduced with certainty. Niger delta, geographical position: 03°57' N: 06°58' E. Collected by J. R. L. Allen, University of Reading, England. Comment: "If the banks formed at a level other than the present one, compaction or isostatic or tectonic sinking must have occurred." (2,3,4,5,6).

11. GRO-1194 Takoradi, Ghana

5570 ± 70
3620 BC

Mangrove wood from a fossil forest, exposed below high-water mark, lying on the surface of continental deposits, which were flooded by the second Holocene transgression. This Transgression has recently been recognized at a number of places along the African coast. In the continental deposits, artefacts occurred from the end of the Middle Stone Age. Submitted by O. Davies, University College, Achimota, Ghana (6,7).

12. T-4013 Bougdouma, Manga, Niger

5900 ± 140
3950 BC

Organic material in a silt at a height of 2.50m. (2,3). No other data published.

13. T-404 Nouakchott, Mauretania

5570 ± 120
3620 BC

Shells of *Arca senilis* from a raised beach at a height of plus 1m. to plus 2m. (2,3).

14. T-403 Fann, Dakar, Senegal

1910 ± 100
40 AD

Shells of *Patella safiana* from a raised beach at plus 2m. (2,3).

DEACON - RADIO CARBON DATES

B. III. LATER STONE AGE DATES

a. SOUTH AFRICA

Lab. No.	Date $\frac{B.P.}{B.C.}$	Site	Associations	Sample	Reference
1. Y-1324	$\frac{11,250 \pm 200}{10,300 \text{ BC}}$	Uitkomst Cave, Transvaal	Smithfield	Charcoal	9
2. ?Y-1323A	$\frac{9630 \pm 200}{7680 \text{ BC}}$	" "	"	"	"

b. CENTRAL AFRICA

3. LV-46	$\frac{3080 \pm 170}{1130 \text{ BC}}$	Mt. Amba, Congo	Clearing of forest	Charcoal	12
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ADDITIONAL NOTES ON LATER STONE AGE DATES

- | | |
|------------------------------------|------------------|
| 1. Y-1324 Uitkomst Cave, Transvaal | $11,250 \pm 200$ |
| | 10,300 BC |
| 2. ?Y-1323A | 9630 ± 200 |
| | 7680 BC |

Charcoal from the Later Stone Age Bed I deposits at Uitkomst Cave, excavated by R. J. Mason. The laboratory number for the younger date has not been published, but the one quoted above is probably correct, since Y-1323B is quoted (9). Y-1323A was collected from an Iron Age furnace in Bed 2, but represents Later Stone Age contamination as the furnace was dug into the Later Stone Age deposit. The Later Stone Age industry is represented by a small sample which has been assigned to the middle stage of the Smithfield Culture in the Transvaal (9.10.11).

- | | |
|--------------------------|----------------|
| 3. Lv-46 Mt. Amba, Congo | 3080 ± 170 |
| | 1130 BC |

Charcoal from Mt. Amba, Louvanium Plateau ($4^{\circ}26' S$; $15^{\circ}18' E$), Province of Leopoldville, Congo. From a sterile layer. The same layers of charcoal often occur around Leopoldville, in yellow sand, at a depth of 1m.

Comment: "Charcoal is probably a consequence of clearing forest." This date is one of a series of samples related to prehistoric industries in the Leopoldville plain. Collected by H. V. Moorsel, Prehistorical Museum, Louvanium University, Leopoldville, Congo (10,12).

DEACON - RADIO CARBON DATES

B. IV. IRON AGE DATES

b. CENTRAL AFRICA

Lab. No.	Date $\frac{\text{B.P.}}{\text{B.C.}}$	Site	Associations	Sample	Reference
1. L-395C	$\frac{1400 \pm 150}{\text{AD } 550}$	Kalambo Falls, Zambia	Channel-decorated pottery	? Charcoal	15
2. B-233	$\frac{940 \pm 110}{\text{AD } 1010}$	Umtali, Rhodesia	Iron Furnace	Charcoal	17

d. WEST AFRICA

3. Sa-100	$\frac{3150 \pm 300}{3190 \text{ BC}}$	Adrar Bous III, Ténéré, Niger	Neolithic	Charcoal	18
4. Gif-76	$\frac{3320 \pm 200}{1400 \text{ BC}}$	Fachi, Ténéré, Niger	Dwellings covered by dune	Bone	3
5. T-399	$\frac{340 \pm 110}{1600 \text{ AD}}$	Sado, Foga, Niger	Ancient salt works	Charcoal	3
6. T-402	$\frac{230 \pm 80}{1720 \text{ AD}}$	Karagou Gamdwa, Manga, Niger	" " "	"	"

ADDITIONAL NOTES ON IRON AGE DATES

1. L-395C Kalambo Falls, Zambia

 1400 ± 150

AD 550

Sample of charcoal from 9.5 to 10ft. deep. **Comment** (B. M. F.): "There is every indication that channel-decorated pottery-makers were living at Kalambo Falls for at least a thousand years." (15, 16). This date was originally published without the laboratory number (15).

2. B-233 Umtali, Rhodesia

 940 ± 110

1010 AD

Charcoal found in a niche below an iron-furnace in a kraal (walled village) of Inyanga culture near Ziwa farm ($18^{\circ}55' S$; $32^{\circ}33' E$). Collected 1958 by F. O. Bernhard, Umtali, and submitted by H. G. Bandi, Historisches Museum, Bern, Switzerland. **Comment**: "The sample was taken in the deepest culture layer found, accompanied by pottery of a pre-Inyanga culture." (17, 10 p. 65).

3. Sa-100 Adrar Bous III, Ténéré, Niger

 5150 ± 300

3190 BC

Charcoal from a hearth in a Neolithic deposit at Adrar Bous ($20^{\circ}20' N$; $9^{\circ}8' E$). Collected 1960 and submitted by H. Hugot, Musée Bardo, Université d'Alger. **Comment**: "Adrar Bous III is a very important Neolithic station (10,000 sq. miles) of Ténéréen culture discovered in 1960 on the bank of a fossil lagoon. Many bones of bovines, hippopotamus and catfish, shells of lake oysters (*Aetheria*) and an industry of beautiful polished axes of green jasper, arrows and tools of quartz, flint and haematite, crushing stones and pottery, show that the culture was based on fishing, hunting and agriculture. Like the similar Es-Shaheinab industry, dated at 5100 ± 450 and 5450 ± 380 (20), it is supposed to be a western extension of the pre-dynastic Egyptian civilization (21, 22). Palynologic study of the diatomite floor of the dry lagoon has shown a mediterranean flora (*Phyllrea*, *Quercus ilex*, *Pistacia lentiscas*, *Alnus glutinosa*, *Cupressus*, *Juniperus*, *Pinus*, *Tilia*, etc.)." (23, 18).

4. Gif-76 Fachi, Ténéré, Niger

 3350 ± 200

1400 BC

Hippopotamus bones from 30 kms. west of Fachi (2, 3). Dates dwellings above diatomite and covered by modern dune (O. Davies, pers. comm.).

5. T-399 Sado, Foga, Niger

 350 ± 110

1600 AD

Charcoal from an ancient salt works (2, 3).

6. T-402 Karagou Gamdwa, Manga, Niger

 230 ± 80

1720 AD

Charcoal from an ancient salt works (2, 3).

DEACON - RADIO CARBON DATES

C. DATES OF PALAEOENVIRONMENTAL INTEREST

c. EAST AFRICA

Lab. No.	Date $\frac{\text{B.P.}}{\text{B.C.}}$	Site	Associations	Sample	Reference
1. GrN-3526	$\frac{7330 \pm 90}{5380 \text{ BC}}$	Lake Rutundu, Kenya	Pollen analysis	Lake bottom deposits	24
2. GrN-3511	$\frac{6135 \pm 85}{4185 \text{ BC}}$	" "	" "	" "	"
3. GrN-3515	$\frac{910 \pm 45}{1040 \text{ AD}}$	Lake Narasha, Kenya	No great value for pollen analysis	" "	"
4. GrN-3517	$\frac{680 \pm 55}{1270 \text{ AD}}$	Lake Naivasha, Kenya	" " "	" "	"
5. GrN-3510	$\frac{380 \pm 60}{1570 \text{ AD}}$	Yatta Camp, Kenya	Not specified	Hydora rhizomes	24

ADDITIONAL NOTES ON DATES OF PALAEOENVIRONMENTAL INTEREST

1, 2. Lake Rutundu, Kenya

Bottom deposits from a crater lake on Mt. Kenya, water depth 5.50m. Geographical position $0^{\circ}02'30''$ S; $37^{\circ}27'46''$ E; altitude 10,200ft. Submitted by E.M. Van Zinderen Bakker, University of the Orange Free State, South Africa. Core investigated by Miss J.A. Coetzee (24).

GrN-3526 12.10 - 1240m. below water surface 7330 ± 90

5380 BC

GrN-3511 11.60 - 11.90m. " " " 6135 ± 85

4185 BC

3. GrN-3515 Lake Narasha, near Timboroa, Kenya

910 ± 45

1040 AD

Geographical position $0^{\circ}05'30''$ N; $35^{\circ}33'$ E. Altitude 9,050ft., near the tree line. Water depth 8m. This lake is apparently very young and therefore not of great value for pollen analysis (24).

4. GrN-3517 Lake Naivasha, Rift Valley, Kenya

680 ± 55

1270 AD

Bottom deposit of the crater lake on the eastern side of the main lake. Geographical position $0^{\circ}45'49''$ S; $36^{\circ}24'36''$ E. Water depth 12m. This core is too young for pollen analysis. The borer could not penetrate deeper (24).

5. GrN-3510 Yatta Camp (near B2), Kenya

380 ± 60

1570 AD

Hydora rhizomes at geographical position $1^{\circ}08'53''$ S; $37^{\circ}43'20''$ E; at an altitude of 3,900ft. Depth 60-74cm. Collected by C.G. Trapnell and R.M. Scott. No details published (24).

CORRIGENDA

The following corrections should be noted for "An annotated list of radio-carbon dates for sub-Saharan Africa", **Ann. Cape Prov. Mus.** V, 5-84.

Page 16, last line: "... at an altitude of 48m. ..." should read "... at an altitude of 4.8m ..).

Page 25 and 28, date no. 8, **Olieboompoort, Transvaal**: the date should read · 35,000 years. After publication of the date as · 25,000, the laboratory did a re-count. (Mason, **pers. comm.**)

Page 27, line 29: read C-851 and C-852 for C-581 and C-582.

Page 50ff. read Isamu Pati for Isamu Pate (Fagan, **pers. comm.**)

Page 51 and 60: date no. 35, **Ingombe Ilede, Zambia**: R-908 (NZ), date should read 1270 ± 40 (AD 680). This result is a re-count of the same number as the original reading was the result of a fault in the apparatus (Fagan, **pers. comm.**).

Page 43, **Scelerocayre** read **Sclerocarya**

ACKNOWLEDGEMENTS

I am most grateful to Professor O. Davies for drawing my attention to the majority of the dates published in this present paper, and to Miss R. M. Tietz for preparing the index.

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